NEW SERIES
Vol. VI

No. 1

Bulletin

of

Armour Institute of Technology

GENERAL INFORMATION NUMBER

May-1912

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CHICAGO, ILLINOIS

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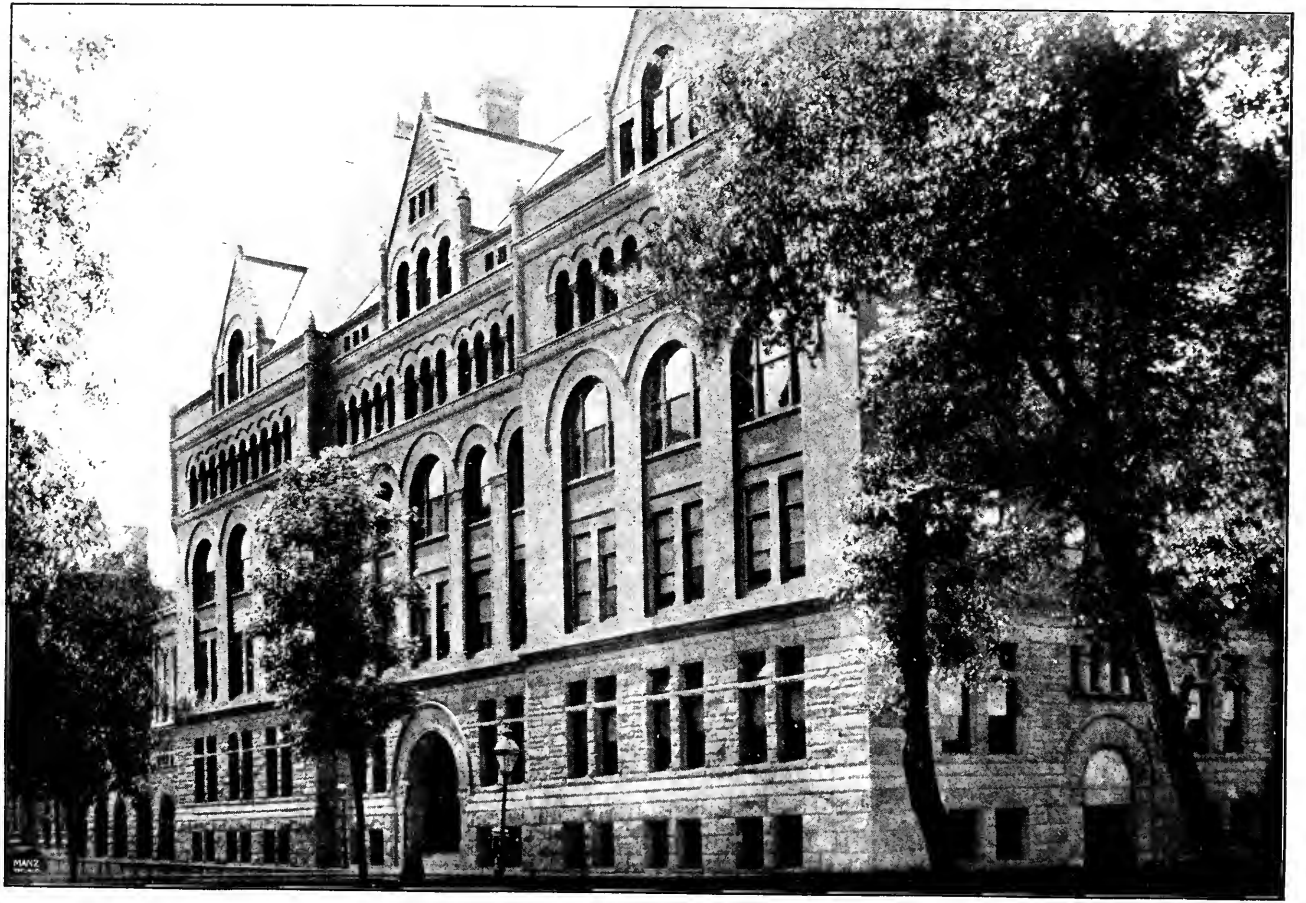

MAIN BUILDING.

Bulletin

of

Armour Institute of Technology

CHICAGO

FOUNDED BY PHILIP D. ARMOUR

GENERAL INFORMATION

May - 1912

CHICAGO
ARMOUR INSTITUTE OF TECHNOLOGY PRESS
1912

1912

JANUARY

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1913

JANUARY

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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INSTITUTE CALENDAR

1912

June 6	Thursday	Entrance Examinations.
June 24	Monday	Summer Session Begins.
August 2	Friday	Summer Session Ends.
September 5	Thursday	Entrance Examinations.
September 9	Monday	First Semester of the College Year 1912-1913 Begins; Registration Day.
October 7	Monday	Evening Classes (First Term) Begin.
Nov. 28 and 29	Thursday and Friday	Thanksgiving Holidays.
December 13	Friday	Evening Classes (First Term) End.
Dec. 23 to Jan. 4, 1913	. . . . .	Midwinter Recess.

1913

January 6	Monday	Evening Classes (Second Term) Begin.
January 25	Saturday	First Semester Ends.
January 27	Monday	Second Semester Begins; Registration Day.
February 12	Wednesday . . .	Lincoln's Birthday, a Holiday.
February 22	Saturday	Washington's Birthday, a Holiday.
March 14	Friday	Evening Classes (Second Term) End.
March 17	Monday	Evening Classes (Third Term) Begin.
March 21	Friday	Good Friday, a Holiday.
May 23	Friday	Evening Classes (Third Term) End.
May 25	Sunday	Baccalaureate Sermon.
May 29	Thursday	Commencement Exercises.
May 31	Saturday	Second Semester Ends.

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HISTORY.

Armour Institute of Technology was founded in 1892 by Mr. Philip Danforth Armour of Chicago. The work of instruction was begun in September, 1893. The aim of the Institute was expressed in its first public announcement as follows:

"This institution is founded for the purpose of giving to young men an opportunity to secure a liberal education. It is hoped that its benefits may reach all classes. It is not intended for the poor or the rich, as sections of society, but for any and all who are earnestly seeking technical education. Its aim is broadly philanthropic. Profoundly realizing the importance of self-reliance as a factor in the development of character, the Founder has conditioned his benefactions in such a way as to emphasize both their value and the student's self-respect. The Institute is not a free school; but its charges for instruction are in harmony with the spirit which animates alike the Founder, the Trustees, and the Faculty; namely, the desire to help those who wish to help themselves."

Four-year courses in Mechanical and Electrical Engineering were first organized. A union was effected with the Art Institute of Chicago for the purpose of developing the course in Architecture which that institution had successfully maintained since 1889. The result was the establishment in 1895 of the Chicago School of Architecture.

In 1899 the course in Civil Engineering was added; in 1901, the course in Chemical Engineering; and in 1903, the course in Fire Protection Engineering. The courses now offered in Mechanical Engineering, Electrical Engineering, Civil Engineering, Chemical Engineering, Fire Protection Engineering, and Architecture, all lead to the degree of *Bachelor of Science.*

Each of these four-year courses represents a carefully balanced group system of studies, combining a thorough and broad scientific training with the elements of liberal culture.

GOVERNMENT

TRUSTEES.

J. OGDEN ARMOUR. MRS. PHILIP D. ARMOUR.
MRS. J. OGDEN ARMOUR. FRANK W. GUNSAULUS.
JOHN C. BLACK. SIMEON B. CHAPIN.
ROBERT J. DUNHAM

EXECUTIVE COUNCIL.

THE PRESIDENT.
THE COMPTROLLER AND SECRETARY.
THE DEAN OF THE CULTURAL STUDIES.
THE DEAN OF THE ENGINEERING STUDIES.

OFFICERS OF ADMINISTRATION.

The President,
FRANK WAKELEY GUNSAULUS.

The Comptroller and Secretary,
FREDERICK URLING SMITH.

The Dean of the Cultural Studies,
LOUIS CÉLESTIN MONIN.

The Dean of the Engineering Studies,
HOWARD MONROE RAYMOND.

The Registrar,
GEORGE SINCLAIR ALLISON.

The Librarian,
JULIA BEVERIDGE.

OFFICERS OF INSTRUCTION.

(ARRANGED IN GROUPS ACCORDING TO SENIORITY OF APPOINTMENT.)

FRANK WAKELEY GUNSAULUS, D. D., LL. D.,
President.

LOUIS CÉLESTIN MONIN, Ph. D.,
Dean of the Cultural Studies, Professor of Economics and Philosophy.

HOWARD MONROE RAYMOND, B. S.,
Dean of the Engineering Studies, Professor of Experimental Physics.

ALFRED EDWARD PHILLIPS, C. E., Ph. D.,
Professor of Civil Engineering.

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Professor of Mechanical Engineering.

GEORGE LAWRENCE SCHERGER, Ph. D.,
Professor of History and Political Science.

GUY MAURICE WILCOX, A. M.,
Professor of Physics.

DONALD FRANCIS CAMPBELL, M. A., Ph. D.,
Professor of Mathematics.

FITZHUGH TAYLOR, B. S.,
Professor of Fire Protection Engineering.

HENRY BASCOM THOMAS, B. S., M. D.,
Professor of Hygiene, Medical Adviser, and Director of Physical Culture.

WALTER FRANCIS SHATTUCK, B. S.,
Professor of Architecture.

HARRY MCCORMACK, M. S.,
Professor of Chemical Engineering.

ERNEST HARRISON FREEMAN, B. S., E. E.,
Professor of Electrical Engineering.

WALTER KAY SMART, Ph. D.,
Professor of English.

JOHN EDWIN SNOW, A. M., M. S., E. E.,
Associate Professor of Electrical Engineering.

MELVILLE BAKER WELLS, C. E.,
Associate Professor of Bridge and Structural Engineering.

ROBERT VALLETTE PERRY, M. E.,
Associate Professor of Machine Design.

THOMAS EATON DOUBT, Ph. D.,
Associate Professor of Physics.

CHARLES WILBER LEIGH, B. S.,
Associate Professor of Mathematics.

JOSEPH BERNARD FINNEGAN, S. B.,
Associate Professor of Fire Protection Engineering.

CHARLES EDWARD PAUL, S. B.,
Associate Professor of Mechanics.

ARTHUR JOSEPH FRITH, C. E.,
Associate Professor of Mechanical Engineering.

DAVID PENN MORETON, B. S., E. E.,
Associate Professor of Electrical Engineering.

BENJAMIN BALL FREUD, B. S.,
Associate Professor of Organic Chemistry.

ALEXANDER PELL, PH. D.,
Associate Professor of Mathematics.

ANDREW NICHOLAS REBORI, B. S.,
Associate Professor of Architecture.

CHARLES AUSTIN TIBBALS, Ph.D.,
Associate Professor of Analytical Chemistry.

CLYDE BARNES COOPER, A. M.,
Associate Professor of English.

AUGUST RAYMOND ZORN, A. B.,
Assistant Professor of Modern Languages.

HENRY LEOPOLD NACHMAN, B. S., M. E.,
Assistant Professor of Kinematics and Machine Design.

OLIVER CHARLES CLIFFORD, Ph. D.,
Assistant Professor of Electrical Engineering.

HERBERT JULIUS ARMSTRONG, B. S.,
Assistant Professor of Railway Engineering.

WILLIAM EDWARD BARROWS, JR., B. S., E. E.,
Assistant Professor of Electrical Engineering.

CLAUDE IRWIN PALMER, A. B.,
Assistant Professor of Mathematics.

ARTHUR HENRY ANDERSON, B. S., M. E.,
Assistant Professor of Experimental Engineering.

EDWIN STEPHEN LIBBY, B. S., M. E.,
Assistant Professor of Experimental Engineering.

WILLIAM GRISWOLD SMITH, M. E.,
Assistant Professor of Descriptive Geometry and Kinematics.

JOHN SIMPSON REID,
Assistant Professor of Mechanical Drawing and Elementary Machine Drawing.

ROBERT CHARLES OSTERGREN, B. S.,
Assistant Professor of Architecture.

JOHN RINKER KIBBEY, B. S.,
Assistant Professor of Architecture.

STANLEY DEAN, B. S., C. E.,
Assistant Professor of Civil Engineering.

EUGENE EDWARD GILL, PH. D.,
Assistant Professor of General Chemistry.

JULIA BEVERIDGE,
Librarian and Instructor in Bibliography.

EDWARD DIEHL AGLE,
Superintendent of Shops and Instructor in Machine Tool Work.

WILLIAM WAY MANNING,
Instructor in English.

NELS PETER PETERSON,
Instructor in Woodworking.

CHARLES FREDERICK HAGENOW, B. S.,
Instructor in Physics.

CHARLES HENRY FORNHOF,
Instructor in Machine Tool Work.

GEORGE EVERETT MARSH, B. S.,
Instructor in Electrical Engineering.

JAMES CLINTON PEEBLES, B. S., E. E., M. M. E.,
Instructor in Experimental Engineering.

CHARLES E. BOUTWOOD,
Instructor in Freehand Drawing.

JOSEPH PATRICK KENNEDY,
Instructor in Forging.

EARL WATSON MCMULLEN, B. S.,
Instructor in Industrial Chemistry.

HAROLD WILLIAM NICHOLS, M. S., E. E.,
Instructor in Electrical Engineering.

JOHN CORNELIUS PENN, B. S., C. E.,
Instructor in Civil Engineering.

CHARLES LARSEN,
Instructor in Founding.

HARRIE BRIDGMAN PULSIFER, S. B.,
Instructor in Metallurgy.

DANIEL ROESCH, B. S., M. E.,
Instructor in Experimental Engineering.

CHARLES R. SWINEFORD, B. S.,
Instructor in Descriptive Geometry.

CHARLES H. ALLING, JR., LL. B.,
Lecturer on Business Law.

THOMAS E. TALLMADGE, B. S.,
Lecturer on History of Architecture.

SPECIAL LECTURERS.

(During the College Year 1911-1912.)

President Gunsaulus,
The Student of Engineering and his Alma Mater.
Two Great Orators: John Bright and Wendell Phillips.
Some Scenes in Shakespeare.
Charles Dickens.
China and the Orient.

Hon. William Howard Taft, President of the United States,
Address.

Rev. R. J. Campbell, Pastor of City Temple, London, England,
British History and Modern Problems.

Mr. Henry Hornbostel, Architect, New York City.
Development of the Imagination.

Mr. Benjamin Chapin, New York,
A Dramatic Portrait of Abraham Lincoln.

Mrs. Katharine Oliver McCoy, Kenton, Ohio,
Confessions of a Literary Pilgrim.

REQUIREMENTS FOR ADMISSION.

a. *Admission by Certificate.* Applicants for admission holding diplomas of graduation from high schools and academies of good standing may be admitted to the Freshman Class without an examination. When admission is sought in this way, the applicant will be furnished an application blank to be filled out by the principal of the school last attended, certifying to his scholarship and qualifications. The laboratory note books in chemistry and physics and a sample of the applicant's drawing should accompany this application.

b. *Admission by Examination.* Applicants not admitted by certificate are required to pass entrance examinations.

Entrance examinations (for admission and for advanced standing) are held at the Institute on Thursday, June 6, and on Thursday, Sept. 5, 1912, at 9 a. m.; on Thursday, June 5, and on Thursday, Sept. 4, 1913.

Subjects Required for Entrance.

The requirements for admission to the courses in Mechanical Engineering, Electrical Engineering, Civil Engineering, Chemical Engineering, Fire Protection Engineering and Architecture are uniform and amount to *fifteen units.*

A *unit* stands for a course of study covering a school year of not less than thirty-five weeks, with four or five periods of at least forty-five minutes each per week.

Fifteen Units are required for entrance, of which *twelve and one-half* are specified and *two and one-half* may be chosen from a list of electives.

Required Units:

Algebra	1½	units.
Plane Geometry	1	unit.
Solid Geometry	½	unit.
Trigonometry	½	unit.
English	3	units.
Physics	1	unit.
Chemistry	1	unit.
History	1	unit.
Elementary German or Elementary French	1	unit.
Intermediate German or Intermediate French	1	unit.
Mechanical Drawing	1	unit.
Required Subjects	12½	units.
Elective Subjects	2½	units.
Total Units for Entrance	15	units.

Electives (2½ units). In addition to the twelve and one-half units specified above the applicant must also present satisfactory evidence of preparation in two and one-half units of the following electives:

French or	Freehand Drawing,
German (additional,)	English (additional,)
Spanish,	History (additional,)
Latin,	Biology.

In allowing credit for drawing and laboratory work *two* forty-five minute periods are regarded as equivalent to *one* forty-five minute period of class-room work.

Conditions. Candidates failing to receive credit for the fifteen units required may be admitted conditionally provided they are not deficient in more than two subjects. Such "conditions," however, must be made up during the Freshman year.

Detailed Requirements in the Various Subjects.

ALGEBRA (1½ Units).

Factors; common divisors and multiples; fractions; the solution of equations both numerical and literal, of the first and second degrees with one or two unknown quantities; putting problems into equations; surds; imaginaries; ratio; proportion; variation; the progressions; binomial theorem for positive integral powers of the binomial; the extraction of roots; logarithms.

GEOMETRY, PLANE AND SOLID (1½ Units).

The general properties of plane rectilinear figures; the measurement of angles; circles; similar polygons; areas; the relations of planes and lines in space; prisms; pyramids; cylinders; cones; the sphere; the spherical triangle.

TRIGONOMETRY (½ Unit).

Trigonometric functions; measurement of angles; trigonometric functions of angles; solution of trigonometric equations; solution of triangles.

MECHANICAL DRAWING (1 Unit).

Use of instruments, geometrical problems and designs, orthographic projection, inking, shading, lettering, tracing, conventions and working drawings of machines and details. Anthony's *Mechanical Drawing,* and J. S. and D. Reid's *Mechanical Drawing and Machine Design* are suggested for text books.

CHEMISTRY (1 Unit).

General Chemistry.—The equivalent of McPherson and Henderson's *Elementary Study of Chemistry,* or Remsen's *Introduction to the Study of Chemistry.* A record of the laboratory work, vouched for by his instructor, must be presented by each candidate.

PHYSICS (1 Unit).

Any standard text-book, such as Carhart and Chute, *High School Physics,* or Mann and Twiss, *Physics.* The candidate must also present his laboratory note book; his proficiency will be judged rather by the character than by the number of experiments he has made. The experiments outlined in Crew & Tatnall's *Laboratory Manual of Physics* are recommended.

ENGLISH (3 Units).

Written work in English is not accepted when notably defective in spelling, punctuation, grammar, or division into paragraphs.

Grammar.—Special attention is called to the structure of sentences.

Composition.—Kinds of sentences; development of the paragraph; varieties of discourse; qualities of style; principal rhetorical figures; elements of versification; a brief exercise in writing on subjects taken from the list of works specified to be studied critically.

For 1912 and 1913. To be read intelligently. Shakespeare's *Merchant of Venice* and *Julius Caesar; Sir Roger de Coverley Papers* in the Spectator; Goldsmith's *Vicar of Wakefield;* Coleridge's *Ancient Mariner;* Scott's *Ivanhoe;* Carlyle's *Essay on Burns;* Tennyson's *Princess;* Lowell's *Vision of Sir Launfal;* George Eliot's *Silas Marner.*

To be studied critically: Shakespeare's *Macbeth;* Milton's *Comus, Lycidas, L'Allegro and Il Penseroso;* Burke's *Speech on Conciliation with America;* Macaulay's *Life of Johnson.*

Adequate substitutes are permitted for the books named above.

GERMAN, FRENCH OR SPANISH (2 Units).

Two years of consecutive work in either German, French or Spanish are required for entrance. Students receiving credit upon entering for *one* year in each of two languages must complete, during the Freshman year, the work of the second year of one of the languages studied.

HISTORY (1 Unit).

One of the following groups is required:

GROUP *I.—English History.*—The period after 1300 should be carefully studied, with special reference to the rise of manufactures, English trade, the Tudor and Stuart epochs, and the development of Cabinet government since 1688.

GROUP *II.—American History.*—Fiske's *History of the United States* indicates the scope of work on this subject.

GROUP *III.—General History.*—Myer's *General History* indicates the scope of the work required. One year of study should be given to the preparation in history.

Special Notice. Every student is required to file in the office of the Deans a certificate of vaccination, signed by a legally qualified physician, showing *date* and *satisfactory results of vaccination.*

TABULAR VIEW OF COURSES.
MECHANICAL ENGINEERING.

FRESHMAN YEAR.	I.	II.
College Algebra (p. 104)	5	
Analytical Geometry and the Elements of Calculus (p. 104)		5
Qualitative Chemistry: (p. 76)		
Lectures	5	
Laboratory	3	
Quantitative Chemistry: (p. 77)		
Lectures		2
Laboratory		6
Elementary Machine Drawing (p. 36)	4	4
Descriptive Geometry: (p. 36)		
Recitations	2	2
Drawing	2	2
Forging and Pipe Fitting, (p. 39)	3	3
Founding (p. 40)	3	3
English I and II (p. 110)	2	2
History of Civilization (p. 113)	1	1
Physical Culture (p. 120)	2	2
ELECTIVES:		
Advanced French (p. 117)	3	3
Advanced German (p. 117)	3	3

SOPHOMORE YEAR.	I.	II.
Differential and Integral Calculus (p. 105)	5	
Analytical Mechanics (p. 105)		5
Physics (p. 107)	5	5
Political Science (p. 113)	1	
History of Recent Times, (p. 114)		1
English III and IV (p. 111)	1	1
Turning and Carpentry (p. 39)	6	
Pattern Making (p. 39)		6
History of Heat Engines (p. 29)	1	1
Kinematics (p. 30)	3	
Machine Design (p. 30)		3
Machine Drawing (p. 30)	6	6
Inspection Visits.		

The columns refer to the two semesters; the figures indicate the number of hours per week devoted to the subject. The studies are described on the pages indicated after each subject.

MECHANICAL ENGINEERING.

JUNIOR YEAR.	I.	II.
Economics (p. 118).....	2	2
General Laboratory, Physics (p. 108)	3	3
Mechanics of Engineering. (p. 37)	5	5
Machine Tool Work..... (p. 40)	4	4
Experimental Engineering, Lectures (a) (p. 35)....	2	2
Experimental Engineering, Laboratory (a) (p. 34)..	3	3
Steam and Gas Engines: (p. 31)		
Valve Gears	3	
Dynamics, Fly Wheels and Governors		3
Advanced Machine Design: (p. 31)		
Steam Engine	6	6
Oil and Gas Engines....		
ELECTIVE:		
Engineering Chemistry and Metallurgy (p. 83)..		3
Inspection Visits.		

SENIOR YEAR.	I.	II.
Logic (p. 118).....	2	
Psychology (p. 118).....		2
Business Law (p. 114).....	2	
Engineering Contracts and Specifications (p. 73)....		2
Electricity (p. 57):		
Lectures	2	2
Laboratory	3	3
Surveying (p. 73):		
Lecture		1
Field Practice		4
Machine Tool Work..... (p. 40)	4	
Steam Power Plants: (p. 32)		
Thermodynamics	4	
Design and Operation...	1	3
Heating and Ventilation..		2
Gas Power Plants: (p. 33)		
Thermodynamics	5	
Design and Operation....		5
Experimental Engineering:		
Lectures (b) (p. 35)....	1	1
Laboratory (b) (p. 34)..	3	
Engineering Design ..... (p. 34)	6	6
Thesis (p. 39).....		10
ELECTIVES: (One Required)		
Advanced Experimental Engineering (p. 35)...		3
Automobile Engineering.. (p. 33)		3
Refrigerating Engineering (p. 33)		3
Inspection Visits.		

ELECTRICAL ENGINEERING.

FRESHMAN YEAR.	I.	II.	SOPHOMORE YEAR.	I.	II.
College Algebra ..... (p. 104)	5		Differential and Integral Calculus (p. 105).....	5	
Analytical Geometry and the Elements of Calculus. (p. 104)		5	Analytical Mechanics ..... (p. 105)		5
Qualitative Chemistry: (p. 76)			Physics Lectures (p. 107)..	5	5
Lectures	5				
Laboratory	3		General Laboratory Physics (p. 108)	3	3
Quantitative Chemistry: (p. 77)					
Lectures		2	Political Science ..... (p. 113)	1	
Laboratory		6			
Elementary Machine Drawing (p. 36).....	4	4	History of Recent Times.. (p. 114)		1
Descriptive Geometry: (p. 36)			English III and IV (p. 111)	1	1
Recitations	2	2			
Drawing	2	2	Kinematics (p. 36).....	3	3
Forging and Pipe Fitting... (p. 39)	3	3	Kinematical Drawing..... (p. 36)	3	3
Founding (p. 40).....	3	3			
English I and II (p. 110)..	2	2			
History of Civilization..... (p. 113)	1	1	Turning and Carpentry.... (p. 39)	3	3
Physical Culture ..... (p. 120)	2	2			
ELECTIVES:			Theory and Practice of Electrical Measurements. (p. 48)	3	3
Advanced French ..... (p. 117)	3	3			
Advanced German ..... (p. 117)	3	3	Electrical Laboratory ..... (p. 48)	3	3

The columns refer to the two semesters; the figures indicate the number of hours per week devoted to the subject. The studies are described on the pages indicated after each subject.

ELECTRICAL ENGINEERING.

JUNIOR YEAR.	I.	II.
Economics (p. 118).....	2	2
Mechanics of Engineering.. (p. 37)	5	5
Experimental Engineering: (p. 37)		
Lecture	1	1
Laboratory	3	3
Machine Tool Work..... (p. 40)	4	4
Drawing and Designing ... (p. 37)	4	4
Advanced Electrical and Magnetic Measurements and Theory of Direct Current Dynamos ..... (p. 49)	4	
Direct Current Machinery. (p. 49)		4
Electrical Laboratory ..... (p. 50)	3	
Laboratory Methods (p. 50)	1	1
Dynamo Laboratory ..... (p. 52)		3
ELECTIVE:		
Engineering Chemistry and Metallurgy ..... (p. 83)		3
Inspection Visits.		

SENIOR YEAR.	I.	II.
Logic (p. 118).....	2	
Psychology (p. 118).....		2
Business Law (p. 114)....	2	
Alternating Currents and A. C. Machinery (p. 51).	5	
A. C. Machinery and Power Transmission (p. 51)....		5
Central Station Design..... (p. 53)		6
Power Plants (p. 38, 50)..	2	2
Electrical Machinery Design (p. 52)	3	
Operation and Testing of Dynamo Electric Machinery (p. 53).....	1	1
Dynamo Laboratory (p. 52)	3	3
Thesis (p. 58).....		8
***ELECTIVES:**		
Practical Operation of Steam and Gas Engines (p. 38)		3
Surveying: (p. 73)		
Lecture		1
Field Practice		4
Illuminating Engineering:		
Lectures (p. 54).....	2	2
Laboratory (p. 54).....	3	3
Electric Railways (p. 54)..	2	2
Electric Railway Design.... (p. 54)	3	3
Telephony (p. 55).....	2	
Telephone Engineering.. (p. 55)		2
Telephone Laboratory... (p. 56)	3	3
Radiation (p. 108).....	2	
Vector Analysis (p. 57)....		2
Electro-Chemistry: (p. 84)		
Lectures		2
Laboratory		4
Inspection Visits.		

*Candidates for graduation are required to take elective studies of two hours lecture work and three hours laboratory work each semester during the Senior year.

CIVIL ENGINEERING.

FRESHMAN YEAR.	I.	II.	SOPHOMORE YEAR.	I.	II.
College Algebra (p. 104)..	5		Differential and Integral Calculus (p. 105).....	5	
Analytical Geometry and the Elements of Calculus.... (p. 104)		5	Analytical Mechanics ..... (p. 67)	4	4
Qualitative Chemistry: (p. 76)			Physics (p. 107).....	5	5
Lectures	5		Political Science ..... (p. 113)	1	
Laboratory	3		History of Recent Times... (p. 114)		1
Quantitative Chemistry: (p. 77)			English III and IV (p. 111)	1	1
Lectures		2	Kinematics (p. 36).....	3	
Laboratory		6	Kinematical Drawing ..... (p. 36)		3
Elementary Machine Drawing (p. 36).....	4	4	*Railway Location (p. 66)..	3	
Descriptive Geometry: (p. 36)			*Topographical Surveying.. (p. 66)		3
Lectures	2	2	Topographical Drawing ... (p. 66)	3	
Drawing	2	2	Stereotomy (p. 67).....		3
Turning and Carpentry..... (p. 39)	6		Strength of Materials..... (p. 67)		4
Surveying: (p. 66)			Inspection Visits.		
Lectures		3			
History of Civilization..... (p. 113)	1	1			
English I and II (p. 110)..	2	2			
Physical Culture ..... (p. 120)	2	2			
ELECTIVES:					
Advanced French ..... (p. 117)	3	3			
Advanced German ..... (p. 117)	3	3			

The columns refer to the two semesters; the figures indicate the number of hours per week devoted to the subject. The studies are described on the pages indicated after each subject.

*In the Hydro-Electric Engineering course, the subjects, *Theory and Practice of Electrical Measurements,* and *Electrical Laboratory,* as announced in the Electrical Engineering course, page 48, are substituted for Railway Location and Topographical Surveying.

CIVIL ENGINEERING.

JUNIOR YEAR.	I.	II.
Economics (p. 118)	2	2
Applied Mechanics (p. 67)	3	
Theory and Practice of Concrete Design (p. 68)		3
Hydraulics (p. 68)	5	
Experimental Engineering:		
Lecture (p. 37)	1	1
Laboratory (p. 37)	3	3
Stresses in Framed Structures (p. 69)	5	
Graphics (p. 69)	3	
Bridge and Structural Steel Design (p. 69)		6
Structural Details (p. 68)	1	1
***ELECTIVES:**		
Structural Engineering and Railway Engineering:		
Stresses in Framed Structures (p. 69)		5
Graphics (p. 69)	6	
Bridge and Structural Steel Design (p. 69)		3
Railway Construction (p. 68)		5
Hydraulic and Sanitary Engineering:		
Hydraulics (p. 68)		5
Stresses in Framed Structures (p. 69)		5
Graphics (p. 69)	6	
Bridge and Structural Steel Design (p. 69)		3
Hydro-Electric Engineering:		
Power Plants (p. 50)		2
Advanced Electrical and Magnetic Measurements and Theory of Direct Current Dynamos (p. 49)	4	
Direct Current Machinery (p. 49)		4
Laboratory Methods (p. 50)	1	1
Electrical Laboratory (p. 50)	3	
Dynamo Laboratory (p. 52)		3
Water Power Eng. and Topographical Surveying (p. 72)		5

SENIOR YEAR.	I.	II.
Logic (p. 118)	2	
Psychology (p. 118)		2
Business Law (p. 114)	2	
Engineering Contracts and Specifications (p. 73)		2
Masonry and Reinforced Concrete Construction (p. 70)	2	
Masonry Design (p. 72)	3	
Geology (p. 70)		3
Thesis (p. 73)	3	6
***ELECTIVES:**		
Structural Engineering:		
Higher Structures (p. 71)	2	2
Bridge and Structural Steel Design (p. 69)	6	6
Practical Astronomy (p. 70)	3	
Electricity: (p. 57)		
Lectures	2	2
Laboratory	3	3
Masonry Design (p. 72)		3
Roads, Streets and Pavements (p. 71)	3	
Railway Engineering:		
Railway Economics (p. 70)	3	
Railway Construction and Maintenance (p. 70)		3
Railway Drawing (p. 71)	3	3
Practical Astronomy (p. 70)	3	
Masonry Design (p. 72)		3
Bridge and Structural Steel Design (p. 69)	6	6
Electricity: (p. 57)		
Lectures	2	2
Laboratory	3	3
Hydraulic and Sanitary Engineering:		
Hydraulic Engineering (p. 71)	5	
Sanitary Engineering (p. 71)		5
Roads, Streets and Pavements (p. 71)	3	
Electricity: (p. 57)		
Lectures	2	2
Laboratory	3	3
Water and Sewage (p. 83)	4	
Bacteriology and Applied Microscopy (p. 83)		4
Hydraulic Design (p. 72)		3
Hydro-Electric Engineering:		
Alternating Currents and A. C. Machinery (p. 51)	5	
A. C. Machinery and Power Transmission (p. 51)		5
Central Station Design (p. 53)		6
Electrical Machinery Design (p. 52)	3	
Hydraulic Design (p. 72)		3
Operation and Testing of Dynamo Electric Machinery (p. 53)	1	1
Dynamo Laboratory (p. 52)	3	3

*Junior and Senior students are required to take *one group* of elective studies in addition to the prescribed studies.

CHEMICAL ENGINEERING.

FRESHMAN YEAR.	I.	II.
College Algebra (p. 104)..	5	
Analytical Geometry and the Elements of Calculus (p. 104).....		5
Qualitative Chemistry: (p. 76)		
Lectures	5	
Laboratory	3	
Quantitative Chemistry: (p. 77)		
Lecture		2
Laboratory		6
Elementary Machine Drawing (p. 36).....	4	4
Descriptive Geometry: (p. 36)		
Recitations	2	2
Drawing	2	2
Forging and Pipe Fitting.. (p. 39)	3	3
Founding (p. 40).....	3	3
English I and II (p. 110)..	2	2
History of Civilization .... (p. 113)	1	1
Physical Culture ..... (p. 120)	2	2
ELECTIVES:		
Advanced French ..... (p. 117)	3	3
Advanced German ..... (p. 117)	3	3

SOPHOMORE YEAR.	I.	II.
Differential and Integral Calculus (p. 105).....	5	
Analytical Mechanics ..... (p. 105)		5
Physics (p. 107).....	5	5
Political Science (p. 113)..	1	
History of Recent Times... (p. 114)		1
English III and IV (p. 111)	1	1
Quantitative Chemistry: (p. 77)		
Lecture	1	1
Laboratory	6	6
Kinematics (p. 36).....	3	3
Kinematical Drawing ..... (p. 36)	3	3
Organic Chemistry: (p. 78)		
Lectures	3	3
Laboratory	6	
Machine Tool Work..... (p. 40)		4
Inspection Visits.		

The columns refer to the two semesters; the figures indicate the number of hours per week devoted to the subject. The studies are described on the pages indicated after each subject.

CHEMICAL ENGINEERING.

JUNIOR YEAR.	I.	II.	SENIOR YEAR.	I.	II.
Economics (p. 118).....	2	2	Logic (p. 118).....	2	
			Psychology (p. 118).....		2
General Laboratory Physics (p. 108).....	3	3	Business Law (p. 114).....	2	
			Experimental Engineering: (p. 37)		
Electricity: (p. 57)			Lecture	1	1
Lectures	2	2	Laboratory	3	3
Laboratory	3	3			
			Power Plants ..... (p. 38, 50)	2	2
Mechanics of Engineering.. (p. 37)	5	5			
			Metallurgy: (p. 82)		
			(a) Lectures	2	2
			(b) Laboratory	4	4
Drawing and Designing.... (p. 37)	4	4	Electro-Chemistry: (p. 84)		
			Lectures		2
			Laboratory		4
Metallurgy: (p. 80)			Physical Chemistry (p. 84).	3	
(a) Lectures	2	2	Industrial Chemistry: (p. 81)		
(b) Laboratory	3	3	(a) Lectures	3	3
			(b) Laboratory	9	6
Industrial Chemistry: (p. 79)			Thesis (p. 85).....		
			ELECTIVE:		
(a) Lectures	3	3	Chemical Hazards ..... (p. 84)		2
(b) Laboratory	6	6			
			Radiation (p. 108).....	2	
Inspection Visits.			Inspection Visits.		

FIRE PROTECTION ENGINEERING.

FRESHMAN YEAR.	I.	II.	SOPHOMORE YEAR.	I.	II.
College Algebra (p. 104)..	5		Differential and Integral Calculus (p. 105).....	5	
Analytical Geometry and the Elements of Calculus (p. 104).....		5	Analytical Mechanics ..... (p. 105)		5
Qualitative Chemistry: (p. 76)			Physics (p. 107).....	5	5
Lectures	5		Political Science (p. 113)..	1	
Laboratory	3				
Quantitative Chemistry: (p. 77)			History of Recent Times... (p. 114)		1
Lectures		2			
Laboratory		6	English III and IV (p. 111)	1	1
Elementary Machine Drawing (p. 36).....	4	4	Turning and Carpentry..... (p. 39)		6
Descriptive Geometry: (p. 36)			General Construction ..... (p. 97)	3	3
Recitations	2	2			
Drawing	2	2			
Founding (p. 40).....	3	3	Theory and Practice of Electrical Measurements.. (p. 48)	3	3
Forging and Pipe Fitting... (p. 39)	3	3			
English I and II (p. 110)..	2	2	Electrical Laboratory..... (p. 48)	3	3
History of Civilization..... (p. 113)	1	1	Machine Tool Work..... (p. 40)	4	4
Physical Culture ..... (p. 120)	2	2			
ELECTIVES:			Organic Chemistry: (p. 78)		
Advanced French ..... (p. 117)	3	3	Lectures	2	2
			Laboratory	3	
Advanced German..... (p. 117)	3	3			
			Inspection Visits.		

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FIRE PROTECTION ENGINEERING.

JUNIOR YEAR.	I.	II.	SENIOR YEAR.	I.	II.
Fire Protection Engineering: (p. 88)			Fire Protection Engineering: (p. 88)		
Lectures	2	2	Laboratory and Field Inspections	6	6
Laboratory	6	6			
			Electricity:		
			Lectures (p. 57)	2	2
Economics (p. 118)	2	2			
			Electrical Machinery: (p. 90)		
			Laboratory	3	3
General Laboratory Physics (p. 108)	3	3			
			Experimental Engineering: (p. 37)		
			Lecture	1	1
			Laboratory	3	3
Mechanics of Engineering. (p. 37)	5	5			
			Insurance Practice and Schedule Rating (p. 89)	3	
Industrial Chemistry: (p. 79)			Special Hazards (p. 89)	3	
Lectures	3	3			
Laboratory	6	6	Underwriters' Requirements (p. 89)	3	1
			Logic (p. 118)	2	
Heating and Ventilation (p. 99)	2				
			Psychology (p. 118)		2
			Business Law (p. 114)	2	
Chemical Hazards (p. 84)		2			
			Engineering Contracts and Specifications (p. 73)		2
Inspection Visits.	3	3	Thesis (p. 90)		6

ARCHITECTURE.

FRESHMAN YEAR.	I.	II.
College Algebra (p. 104)...	5	
Analytical Geometry and the Elements of Calculus (p. 104).....		5
Descriptive Geometry: (p. 36)		
Recitations	2	2
Drawing	2	2
Shades and Shadows..... (p. 95)		2
Perspective: (p. 95)		
Recitation		1
Drawing		3
Freehand Drawing ..... (p. 95)		3
Design from Description... (p. 96)		2
Architectural Drawing and Elements of Architecture. (p. 96)	20	10
History of Civilization .... (p. 113)	1	1
History of Architecture.... (p. 96)		1
English I and II (p. 110)..	2	2
Physical Culture ..... (p. 120)	2	2
ELECTIVE:		
Advanced French ..... (p. 117)	3	3

SOPHOMORE YEAR.	I.	II.
History of Architecture.... (p. 96)	1	
Physics ..... (p. 107)	5	5
Graphic Statics: (p. 97)		
Recitations	2	2
Drawing	3	3
General Construction ..... (p. 97)	3	3
Perspective: (p. 95)		
Recitation	1	
Drawing	2	
Freehand Drawing ..... (p. 95)	2	2
Water Colors ..... (p. 98)	1	1
Sanitary Engineering ..... (p. 98)		1
Architectural Design ..... (p. 99)	16	16
ELECTIVES:		
Political Science..... (p. 113)	1	
History of Recent Times. (p. 114)		1
English III and IV..... (p. 111)	1	1
Inspection Visits.		

The columns refer to the two semesters; the figures indicate the number of hours per week devoted to the subject. The studies are described on the pages indicated after each subject.

ARCHITECTURE.

JUNIOR YEAR.	I.	II.
Heating and Ventilation.... (p. 99)	2	
Strength of Materials .... (p. 99)		2
History of Architecture.... (p. 96)		1
Steel Construction: (p. 99)		
Recitation	1	1
Drawing	2	2
Freehand Drawing and Drawing from Life..... (p. 95)	2	2
Water Colors ..... (p. 98)	2	2
Outdoor Sketching ..... (p. 98)		2
Architectural Design ..... (p. 99)	22	20
ELECTIVE:		
Economics (p. 118).....	2	2
Inspection Visits.		

SENIOR YEAR.	I.	II.
Architectural Engineering: (p. 100)		
Recitations	1	1
Drawing	3	3
Reinforced Concrete Design (p. 73)	2	
Specifications (p. 100).....	1	
Estimates (p. 100).....		1
Electric Wiring and Illumination (p. 58).....	2	
Thesis		20
***ELECTIVES:**		
Architectural Designing:		
Interior Decoration ..... (p. 100)	2	
Freehand Drawing from Life (p. 95).....	3	
Restorations from Antique Architecture (p. 100)....	2	
Architectural Design ..... (p. 99)	15	
Inspection Visits.		
Architectural Construction:		
Stereotomy (p. 67).....		3
Advanced Architectural Construction (p. 101)....	16	
Detail Drawing (p. 102)...	3	
Planning (p. 102).....	1	
Inspection Visits.		
GENERAL ELECTIVES:		
History of Sculpture ..... (p. 101)	1	
History of Painting ..... (p. 101)		1
Logic (p. 118).....	2	
Psychology (p. 118).....		2
Business Law (p. 114).....	2	

*Candidates for graduation are required to take the *group of studies* included under Architectural Designing, or Architectural Construction, in addition to the prescribed studies of the senior year.

DEPARTMENTS
AND
COURSES OF INSTRUCTION.

I. THE DEPARTMENT OF MECHANICAL ENGINEERING.

George Frederick Gebhardt, M. A., M. E.,
Professor of Mechanical Engineering.

Robert Vallette Perry, M. E.,
Associate Professor of Machine Design.

Charles Edward Paul, B. S.,
Associate Professor of Mechanics.

Arthur Joseph Frith, C. E.,
Associate Professor of Mechanical Engineering.

Henry Leopold Nachman, B. S., M. E.,
Assistant Professor of Kinematics and Machine Design.

Arthur Henry Anderson, B. S., M. E.,
Assistant Professor of Experimental Engineering.

Edwin Stephen Libby, B. S., M. E.,
Assistant Professor of Experimental Engineering.

William Griswold Smith, M. E.,
Assistant Professor of Descriptive Geometry and Kinematics.

John Simpson Reid,
Assistant Professor of Mechanical Drawing and Elementary Machine Drawing.

Edward Diehl Agle,
Superintendent of Shops and Instructor in Machine Tool Work.

NELS PETER PETERSON,
Instructor in Woodworking.

CHARLES HENRY FORNHOF,
Instructor in Machine Tool Work.

JAMES CLINTON PEEBLES, B. S., E. E., M. M. E.,
Instructor in Experimental Engineering.

JOSEPH PATRICK KENNEDY,
Instructor in Forging.

CHARLES LARSEN,
Instructor in Founding.

DANIEL ROESCH, B. S., M. E.,
Instructor in Experimental Engineering.

CHARLES R. SWINEFORD, B. S.,
Instructor in Descriptive Geometry.

The course in Mechanical Engineering is so arranged and graded as to enable the student to become thoroughly conversant with the principles of contemporary engineering practice, and, by persistent association of abstract analysis with practical problems, to prepare him for a successful professional career. Such a course must of necessity be broad and comprehensive; a thorough training in the fundamental engineering principles is of vital importance. The underlying principles in so large a subject preclude an attempt to specialize along any particular line in the course of the four years of undergraduate work. Beginning with the general elementary subject, the student is led by gradual stages to the more strictly professional work, and the theories presented in the lecture room, are, as far as possible, applied to the laboratories, drafting rooms and shops. Particular stress is laid upon the systematic reading of current technical periodicals, the acquirement and maintenance of a technical library, constant recourse to commercial drawings, and repeated visits to manufacturing establishments and power plants.

SUBJECTS OF INSTRUCTION.

Open to students of the Mechanical Engineering Department only.

I. THE HISTORY OF HEAT ENGINES.
Associate Professor Perry.

This subject treats of the origin and growth of heat engines. Their development is traced to the modern forms of steam and gas engines such as the stationary steam engine, steam turbines, locomotives and marine engines, steam pumps and the various types of gas engines.

The development of the accepted types of engine details such as pistons and rods, crossheads, connecting rods and cranks is also taken up and discussed. This is purely a lecture course.

Text-book: Special Notes and Lantern Slides.

One hour per week throughout the Sophomore year.

II. KINEMATICS.

Assistant Professor Nachman.

This course covers the theoretical analysis of pure mechanism and the practical application of it to simple and complex machines; analysis of links, belting, velocity, diagrams, cams, gears and other contact mechanisms; kinematical synthesis; machine tools; automatic machinery. The students are required to visit shops in order to see the application of theory to practice.

Text-book: Barr, *Kinematics of Machinery.*

Three hours per week during the first semester of the Sophomore year.

III. MACHINE DESIGN.

Assistant Professor Nachman.

This course includes a brief outline of the principles of resistance of materials and a study of the properties of such metals as enter generally into the construction of machine parts.

The chief purpose of the course is the development of rational formulae for the design of machine elements and to acquaint the student with the various forms of such elements. Fastenings, machine parts for the transmission of power, for conveying and storing fluids under pressure, engine details, machine frames and hoisting machinery details are thoroughly discussed.

Text-book: Spooner, *Machine Design, Construction and Drawing.*

Three hours per week during the second semester of the Sophomore year.

IV. MACHINE DRAWING.

Assistant Professor Nachman.

This course includes the making of detail working drawings of some machine tool from measurements, the drawing of velocity and other kinematic diagrams, the design of gears, cams, cone pulleys and other machine parts as well as the complete design of some standard machine. The practical application of the principles learned in course I and II are here shown in the drafting room.

Text-book: Notes, blue prints and trade catalogues.

Six hours per week throughout the Sophomore year.

V. STEAM AND GAS ENGINES.

Associate Professor Perry.

(a) Valve Gears.

The course begins with the study of the Zeuner and Bilgram diagrams, with the application of these diagrams to simple slide valves and gradually embraces the analysis and synthesis of flat, piston, unbalanced, single-ported and multi-ported valves, with fixed, shifting and swinging eccentrics; the study of theoretical indicator cards for simple and compound engines, valve ellipse, valve and piston velocity diagrams, link motions, radial gears, Corliss and other trip gears.

A similar analysis is made of the various valves and valve gears of oil and gas engines.

(b) Dynamics, Fly Wheels and Governors.

The work covers the analysis of steam distribution in high, medium and slow speed engines, simple and compound; the mechanical behavior of the fuel and the products of combustion in oil and gas engines and a thorough discussion of the forces involved in the transmission of power from piston to shaft, with a view of determining the fly wheel for a desired steadiness of rotation; the analysis of stresses in rims and arms of fly wheels due to rotation at uniform and varying speeds; fly wheel design for various purposes; the theory and practice in the design and operation of fly ball and shaft governors with a discussion of other methods of governing.

The courses (a) and (b) form a sequence and are given three hours per week throughout the Junior year.

VI. ADVANCED MACHINE DESIGN.

Associate Professor Perry.

(a) Steam Engines.

This subject begins with the application of the Zeuner and Bilgram diagrams to a simple slide valve and gradually embraces the design and analysis of simple unbalanced valves, Corliss valves, and steam actuated valves. The student is expected to select and carry out one of the following problems: (1) The complete analysis and design in detail of a high speed center crank engine with a swinging eccentric; (2) a similar design of the valve gears and cylinder for a single eccentric Corliss engine; (3) the details of a modern link motion as applied to a locomotive and (4) the cylinder and valve gear for a modern engine, using highly superheated steam. In each of the above problems the student is expected to lay out the governor mechanism, calculate the forces transmitted from piston to crank shaft and determine the weight of counter balance and fly wheel necessary for the given conditions.

(b) Oil and Gas Engines.

Under this heading is included the design of the cylinder, valve gear and governing mechanism of a modern two-cycle or four-cycle gas or oil engine.

Text-book: Special Notes and Lectures.

Six hours per week throughout the Junior year.

VII. STEAM POWER PLANTS.

Professor Gebhardt.

(a) Thermodynamics.

This study includes the laws of thermodynamics as applied to vapors; the conversion of heat into work in steam engines, turbines and combined engines and turbines; indicator and temperature entropy diagrams; theory of compounding, steam jacketing and superheating; the thermal and mechanical efficiency of steam engines and the theory and operation of steam auxiliaries used in modern plants.

(b) Design and Operation.

This subject deals with the mechanical equipment of power plants and includes the location of plant, selection and installation of boilers, turbines, engines, heaters, economizers, feed pumps, condensers and other apparatus used in the generation of power. The heat losses are traced from coal pile to switchboard and careful study made of the various methods for reducing their losses. Special attention is paid to the details of construction of plants already in operation and considerable time is devoted to the cost of operation. The subject includes the analysis of load curves with a view of selecting the size and type of prime movers best suited for the given conditions. All of the auxiliaries entering into the construction of a modern steam power plant are analyzed in detail. A brief discussion is made of machines for pumping liquids with a view of producing the best results for given conditions.

(c) Heating and Ventilation.

The general principles of heating and ventilation with a discussion of data and results of important tests showing the relation of theoretical principles to practical construction; the determination of the required amount of humidity of air, radiating surface, pipe and fittings for steam and hot water systems; forced blast systems of heating and ventilation; vacuum systems; heating with electricity; temperature regulations; specifications and business suggestions.

Text-books: Peabody, *Thermodynamics of the Steam Engine;* Gebhardt, *Steam Power Plant Engineering.*

Five hours per week throughout the Senior year.

VIII. GAS POWER PLANTS.

Associate Professor Frith.

(a) THERMODYNAMICS.

This subject embraces the laws of gases, thermal capacities, entropy and thermodynamics of air compressors, gas and oil engines, gas producers and refrigerating machines, and liquefaction of gases.

(b) DESIGN AND OPERATION.

This subject deals with the design and installation of apparatus for the manufacture of fuel or producer gas or for utilizing blast furnace gas; selection of engines and apparatus for developing power by combustion of gas or other fuels in the cylinder; development of power for air compressing plants, for ice making and refrigerating machinery and the analysis of the various elements entering into the design and operation of the modern automobile.

Text-book: Peabody, *Thermodynamics of the Steam Engine.*

Five hours throughout the Senior year.

IX. AUTOMOBILE ENGINEERING (Elective).

Associate Professor Frith.

This subject embraces the theory and operation of the modern automobile and includes the design, operation and testing of internal combustion engines, carburetors, magnetos, radiators, clutches, transmission gearing, mufflers, brakes, springs, tires and the various appurtenances entering into the construction of commercial and pleasure vehicles.

Text-book: Special Notes and Lectures.

Three hours per week throughout the second semester of Senior year.

X. REFRIGERATING ENGINEERING (Elective).

Assistant Professor Libby.

This subject deals with the design and operation of refrigerating machinery; the testing of air machines and vapor compression machines; distillation; evaporation in vacuo; multiple-effect evaporation; choice of fluid; tonnage rating; ice melting effect; design of compressor; the absorption system; ice making and commercial refrigeration.

Text-book: Special Notes and Lectures.

Three hours per week throughout the second semester of Senior year.

XI. EXPERIMENTAL ENGINEERING LABORATORY.

Associate Professor Frith, Assistant Professors Anderson and Libby, Messrs. Peebles and Roesch.

A systematic study of the methods of engineering investigation so arranged as to afford application of the fundamental principles and theory given in the class room. The student acquires skill in the use and adjustment of scientific engineering apparatus and in the practical operation and testing of steam and gas engines, boilers, pumps and other engineering devices. Great stress is laid on the importance of accurate observation and the correct interpretation of experimental data. Special attention is given to the construction of engineering reports based upon the results of laboratory experiments. All students in this subject when sufficiently advanced are given opportunities of assisting in efficiency tests of power plants, electric lighting stations, street railways and other large plants in the city.

(a) JUNIOR YEAR.

Tests of the strength of materials in tension, compression, crossbending and torsion; experimental study in cement and concrete mixtures; standard tests of paving brick and building stone; hydraulic engineering, embracing the study of water flow through pipes; weirs; nozzles; Venturi meters; rams; turbines; centrifugal pumps and other hydraulic machinery; calibration of dynamometers; gauges; meters; indicator springs; testing of lubricants; analysis of flue gas; fuel calorimeters; valve setting and indicator tests; determination of the quality of steam; tests of fans and blowers.

Three hours per week throughout the Junior year.

(b) SENIOR YEAR.

Experimental study and efficiency tests of steam pumps and injectors; various types of hot air, gas and steam engines; steam turbines; air compressors; high temperature measurement; efficiency tests of the Corliss engine under different working conditions; application of the entropy diagram and Hirn's analysis; evaporation trials of boilers; efficiency tests of automobile engines and accessories; tests of refrigerating apparatus; special research.

Text-book: Carpenter, *Experimental Engineering.*

Three hours per week during the first semester.

XII. ENGINEERING DESIGN.

Professor Gebhardt and Associate Professor Perry.

This course includes the design of boilers, gas producers, gas engines, turbines or special machinery and the complete layout of a power plant.

Six hours per week throughout the Senior year.

XIII. EXPERIMENTAL ENGINEERING LECTURES.

Associate Professor Frith, Assistant Professors Anderson and Libby, Messrs. Peebles and Roesch.

(a) Materials and Hydraulics.

Study and discussion of the methods of engineering research in structural materials, hydraulics, power measurement, lubrication, combustion and other subjects involved in the Junior laboratory experiments.

Text-book: Carpenter's *Experimental Engineering.*

Two hours per week throughout the Junior year.

Prerequisites: Analytical Mechanics; Physics. Mechanics of Engineering must be taken in conjunction with this course.

(b) Steam and Gas Engines.

Steam and gas engineering, with special reference to the methods of testing and carrying on experimental investigations connected with steam engines, gas engines, producers, pumps, turbines, boilers and other appliances.

One hour per week throughout the Senior year.

Prerequisites: Experimental Engineering Laboratory IX (a); Thermodynamics to be taken in parallel.

XIV. ADVANCED EXPERIMENTAL ENGINEERING (Elective).

Professor Gebhardt.

This study involves a laboratory investigation on some subject of engineering interest, or the design and construction of apparatus for experimental work. The student is thus given the opportunity of performing original work of a high order. At the end of each semester a report is presented covering the work done.

Three hours per week throughout the second semester of Senior year.

The following subjects are open to students of other departments:

XV. MECHANICAL DRAWING.

Assistant Professor Reid.

This course consists of Freehand Lettering, Geometrical Drawing, Orthographic Projection, Intersections and Developments, Isometrical Drawing, and two plates of Elementary Machine Drawing or all that is contained in the college preparatory course given in Reid's Mechanical Drawing. It covers the requirements for admission. Two three-hour periods of fifty minutes each for one year of thirty-six weeks.

Text-book: Reid, *Mechanical Drawing.*

XVI. ELEMENTARY MACHINE DRAWING.

Assistant Professor Reid and Mr. Swineford.

This is a continuation of the preparatory course in Mechanical Drawing. The aim is to familiarize the student with the forms and proportions of the simpler machine parts and to prepare him for the course in Machine Design offered in the Sophomore year.

The course is given from text-book and models of modern machines and parts of machines.

Text-book: J. S. and D. Reid, *Machine Drawing and Designing.*

Four hours per week throughout the Freshman year of all courses except Architecture.

XVII. DESCRIPTIVE GEOMETRY.

Assistant Professor Smith and Mr. Swineford.

This subject includes the representation of all geometrical magnitudes and the relation between the point, line and plane; surfaces, including double, curved, warped and tangent planes; solids, with their intersections and the development of their surfaces. The class room work is followed in the drafting room by problems and practical applications.

Text-book: Smith, *Descriptive Geometry.*

Recitations, two hours per week; drawing, two hours per week, throughout the Freshman year of all courses.

XVIII. KINEMATICS.

Assistant Professor Smith.

Same as II. and III., except that the course extends throughout the year with special reference to the needs of Electrical, Civil and Chemical Engineering students.

Text-books: Barr, *Kinematics of Machinery;* Low & Bevis, *Machine Design.*

Three hours per week throughout the Sophomore year of the Chemical and Electrical Engineering courses, and three hours per week during the first semester of the Civil Engineering course.

XIX. KINEMATICAL DRAWING.

Assistant Professor Smith.

Same as IV., except that more stress is laid upon the subjects pertaining to Electrical, Civil and Chemical Engineering.

Text-books: Trade catalogues and commercial drawings.

Three hours per week throughout the Sophomore year of the Chemical and Electrical Engineering courses, and three hours per week during the second semester of the Civil Engineering course.

XX. DRAWING AND DESIGNING.

Assistant Professor Nachman.

This is an advanced course in the design of steam, and other machinery. The problems include the design of the cylinder and details of a high speed engine, the design of a boiler or an evaporator and the complete design of some machine such as a punch or horizontal press.

Text-books: Trade catalogues, commercial drawings and notes from current technical periodicals.

Four hours per week throughout the Junior year of the Electrical and Chemical Engineering courses.

XXI. EXPERIMENTAL ENGINEERING.

Associate Professor Frith, Assistant Professors Anderson and Libby, Messrs. Dietzsch and Peebles.

(a) LECTURES.

This course is intended to help the student to an understanding of the laboratory experiments. The objects of the experiment, the discussion of the apparatus employed and the method of performance are taken up thoroughly in the class room the week preceding the laboratory period.

One hour per week throughout the Junior year of the Electrical and Civil Engineering courses and the Senior year of the Chemical and Fire Protection Engineering courses.

(b) LABORATORY.

The purpose of this course is to give the Electrical, Civil, Chemical and Fire Protection Engineering students a conception of the principles of Mechanical Engineering and to familiarize them with the best methods of test trials and with the commercial efficiency of boilers, pumps and engines. Attention is also given to the determination of the strength of materials, tests of hydraulic and steam machinery, cement testing and the calibration of the instruments used in engineering.

Text-book: Carpenter, *Experimental Engineering.*

Three hours per week throughout the Junior year of the Civil Engineering courses and three hours per week during the first semester and for the first eight weeks during the second semester of the Junior year of the Electrical Engineering course, and three hours per week throughout the Senior year of the Chemical and Fire Protection Engineering courses.

XXII. MECHANICS OF ENGINEERING.

Associate Professor Paul.

(a) STRENGTH OF MATERIALS.

The laws of stresses and deformations in different materials of construction are discussed, and the methods of determining the shearing

forces and bending moments in beams are explained. The fundamental formulæ are deduced for the designing of parts of machinery in general, of beams, shafts, riveted joints and pipes.

Text-book: Church, *Mechanics of Engineering.*

(b) GRAPHICS.

This is an elementary treatment of graphical statics with problems in the determination of friction in mechanism, of stresses in bridge and roof trusses, and of the moments of resistance and inertia of beams and rotating bodies.

Text-book: Church, *Mechanics of Engineering.*

(c) HYDRAULICS.

Attention is given to the flow of water through orifices, weirs, nozzles, canals and pipes; to the laws of fluid friction, pressure of jets and water motors; to the different types of water wheels and turbines, and to the theory and practice of designing and testing turbines.

Text-book: Church, *Mechanics of Engineering.*

The courses a, b, c form a sequence and are given five hours per week throughout the Junior year of the Mechanical, Electrical, Chemical and Fire Protection Engineering courses.

Prerequisites: Mathematics, Courses III and IV.

XXIII. PRACTICAL OPERATION OF STEAM AND GAS ENGINES (Elective).

Associate Professor Frith and Assistant Professor Libby.

This course is arranged for the purpose of giving Seniors in the Electrical, Chemical, Civil and Fire Protection Engineering courses an opportunity of acquiring practical knowledge of the construction, operation and management of Corliss and other steam engines, steam boilers and gas engines. It consists of laboratory work supplemented by lectures extending over a period of about three weeks in the latter part of the second semester.

XXIV. POWER PLANTS.

Associate Professor Perry.

This is a brief course to aid the student in the correct design of a power plant. The work covers the description and purpose of each part of the plant and gives the methods of determining the sizes and types of engines, boilers, heaters, condensers, pumps, piping, etc.

Text-book: Gebhardt, *Steam Power Plant Engineering.*

Two hours per week during the first semester of the Senior year of the Electrical and Chemical Engineering courses.

THESIS.

The subject for thesis investigation is assigned to the student by the Professor of Mechanical Engineering four weeks before the close of the first semester. The thesis may, at the discretion of the student, involve either an original design with complete drawings and specifications, or an experimental investigation. The student is strongly advised to begin his preliminary work early in the second semester. *About 180 hours are devoted to the work during the last ten weeks of the second semester.*

SHOP WORK.

I. TURNING, CARPENTRY AND PATTERN MAKING.

Mr. Peterson.

This work is designed to give a full and complete knowledge, not only of hand work, but also of the practical uses of modern machinery in the working of wood. The work in pattern making requires the construction of patterns for machines, or for parts of machines, from drawings, and not, as usual, from a special drawing made for the pattern.

Turning: The lathe, its tools and their uses; practical turning between centers; chuck, ornamental and pattern turning.

Carpentry: Carpentry as applied to the uses and values of the different woods for general and for special work and practice as related to sawing, planing, joining and structural work of all kinds from drawings; correct methods of grinding, sharpening and adjusting the tools used.

Pattern Making: Pattern making in its relation to molding; the practical construction of patterns to prevent warping and distortion; the making of special patterns, cores and core boxes, introducing draft, shrinkage, finish and the technical appliances and usages of modern pattern work.

Six hours per week throughout the Sophomore year of the Mechanical Engineering course; three hours per week throughout the Sophomore year of the Electrical Engineering course; six hours per week during the second semester of the Sophomore year of the Fire Protection Engineering course, and six hours per week during the first semester of the Freshman year of the Civil Engineering courses.

II. FORGING AND PIPE FITTING.

Mr. Kennedy.

The work in forging includes the treatment of iron and steel; the uses of the fuller, swage, punch and set hammer; drawing, forming and upsetting; scarf, butt and jump welding of iron; welding of carbon steels; forging blacksmiths' tools; treatment of tool steel; forging and tempering of lathe and planer tools; use of steam and power hammer

in heavy forging; tempering of taps, reamer and milling cutters; tempering for wood-working tools; forging of steel rings without welding.

The work of pipe fitting includes the following subjects: Use of adjustable pipe dies, cutting and threading pipe, measuring and fitting pipe, 45-degree angle work, cutting and threading pipe on pipe-threading machine, work with flanged fittings and bending of iron and copper pipes.

Three hours per week throughout the Freshman year of the Mechanical, Electrical, Chemical and Fire Protection Engineering courses.

III. FOUNDING.

Mr. Larsen.

The following subjects are treated: Working conditions of the sand, use and care of tools, molding of two and three part patterns in iron, brass, aluminum and white metal, properties and mixtures of the alloys for brass, white metal and aluminum, management of the cupola, care and handling of the molten metals. In conjunction with the practical molding, the details of the core-making and oilsand match-making are taught. Lectures and demonstrations are given on the theoretical side of foundry work and on the latest labor-saving devices.

Three hours per week throughout the Freshman year of the Mechanical, Electrical, Chemical and Fire Protection Engineering courses.

IV. MACHINE TOOL WORK.

Mr. Agle and Mr. Fornhof.

The work includes the following: Bench work, filing, fitting and finishing of work in cast iron, wrought iron and steel; operation and use of drill press, hand lathe, engine lathe, shaper, plain milling machine; theory of and practice in the grinding of cutting edge tools used in general machine shop practice; planer work; the construction and operation of the engine lathe as applied to turning, boring, screw cutting and chucking of cast iron, wrought iron and all metals used in general engineering practice; screw machine; universal grinding machine; surface grinding machine; the universal milling machine, its construction and operation, including the divided head stock; use of the micrometer and vernier calipers; tool making; cutting of spur, spiral and bevel gears.

Four hours per week throughout the Junior year and during the first semester of the Senior year of the Mechanical Engineering course; four hours per week during the second semester of the Sophomore year of the Chemical Engineering course; four hours per week during the entire Sophomore year of the Fire Protection Engineering course; four hours per week throughout the Junior year of the Electrical Engineering course.

LABORATORY AND SHOP EQUIPMENT.

MATERIALS AND CONSTRUCTION.

This laboratory is fully equipped with standard and special apparatus for testing materials of engineering, and offers exceptional facilities for commercial work as well as for scientific research. The equipment includes a complete assortment of extensometers, cathetometers and other instruments necessary for experimental work, and the following testing machines: Riehlé testing machine of 200,000 pounds capacity, provided with autographic recording apparatus; a 60,000 pound Olsen machine; a 20,000 pound Riehlé machine; Olsen torsion testing machine of 4,000 foot pounds capacity, capable of receiving specimens of shafting 1½ inches in diameter and up to 5 feet in length; a Thurston autographic torsion testing machine; a 50,000 pound Riehlé belt testing machine; a 10,000 pound Olsen wire testing machine; a standard M. C. B. drop testing machine.

CEMENT AND BUILDING MATERIALS.

The cement laboratory is provided with the necessary devices and appliances for the experimental study and testing of cements, concrete, brick, stone, mortar, bitumen, and materials of like nature. The equipment consists of the standard apparatus for the rattler tests of paving brick; a Riehlé cement testing machine of 2,000 pounds capacity and of 1,000 pounds capacity; Fairbanks cement testing machine of 1,000 pounds capacity; a large variety of smaller apparatus and accessories, including briquette and concrete moulds, cement and sand sieves, Gilmore and Vicat needles; apparatus for specific gravity of cement; absorption, boiling and other tests; also a standard penetrometer and ductility testing machine for determining the consistency and strength of bitumen and road materials.

HYDRAULIC ENGINEERING.

This laboratory is intended to afford examples of the practical application of hydraulic principles. An ample supply of water is obtained through a three-inch pipe from the city water main, which communicates with a reservoir of 4,000 gallons capacity. The equipment includes a 12x12 Marsh steam pump provided with pressure regulator and large air chamber; a Marsh steam pump capable of generating 10,000 pounds per square inch water pressure; a Dayton centrifugal single stage pump driven by a 10 horse power Interpole variable speed motor, the pump discharge being measured over a 14 inch weir notch located in an appropriate tank; three stage Worthington pump direct connected to 40 horse power steam turbine; Pelton water wheel with Woodward governor; hydraulic ram; various forms

of weir notches; measuring and weighing tanks; a miscellaneous assortment of hook gauges, Pitot tubes and other small apparatus for the study of hydraulic phenomena.

GAS ENGINEERING.

A well equipped fire-proof laboratory is devoted exclusively to gas engineering. The present equipment includes a 40 horse power Smith hard coal suction producer; an 8x10 three-cylinder Westinghouse gas engine of 40 horse power; a 25 horse power two-cylinder 8x10 I. H. C. gasoline engine; a 7 horse power Fairbanks-Morse engine; a 40 horse power, four-cylinder Rutenber automobile engine; a 20 horse power four-cylinder Continental Automobile engine; a 7 horse power De La Vergne kerosene engine; a 40 horse power Halladay 1911 touring car chassis, mounted on an endless belt absorption dynamometer and completely equipped for scientific testing; a Carpentier optical gas engine indicator; a Rider hot air engine; a Curtis 8x10 duplex air compressor; a Westinghouse air compressor with an air meter; several large commercial centrifugal blowers; and experimental centrifugal blower, belt driven by a 5 horse power Interpole variable speed motor and arranged so impellers of various designs may be used; a good assortment of low pressure manometers for centrifugal blower work, capable of being read to five one-thousandths of an inch; a meter prover; a Westinghouse high pressure meter with special test dial; a Griffin experimental meter; a Junker gas calorimeter; a complete equipment of gas engine indicators and other instruments and small apparatus used in experimental work. Means are provided for operating the engines either on natural or illuminating gas, gasolene, alcohol or crude oil.

LUBRICATION AND OIL TESTING.

This laboratory offers advantages for the commercial testing of lubricants, as well as for experimental research and the study of problems in lubrication. The following is a partial list of apparatus: Several forms of viscosimeter, including the Tagliabue, Carpenter and others of special design; flash and fire test apparatus; Cornell oil testing machine; Thurston standard lubricant tester; apparatus for studying cylinder lubrication under actual working conditions; Westphal balance, hydrometers and other instruments for the determination of specific gravity; a complete assortment of auxiliary apparatus for the physical testing of lubricating oils, greases, and the study of anti-friction bearing metals.

CALORIFIC VALUE OF FUELS.

The laboratory for the study of fuels is provided with scientific apparatus of the highest accuracy, as well as the standard commercial forms in general use. Determinations are made of the composition and

calorific value of solid, liquid and gaseous fuels of all kinds. The laboratory equipment includes the Mahler Bomb, Carpenter and Parr fuel calorimeters, the Junker gas calorimeter, oxygen tanks, chemical balances, drying ovens, muffles and other apparatus for the analysis and heat evaluation of fuels.

PYROMETRY.

The laboratory is exceptionally well provided with instruments for the measurement of high temperatures and the calibration of thermometers and pyrometers. The apparatus includes Callander platinum resistance thermometers with Whipple indicator and recording apparatus suitable for temperatures up to 2,500 degrees F.; Le Chatelier thermo-electric couple pyrometer with milli-voltmeter, for temperatures up to 2,900 degrees F.; platinum and clay ball calorimeters for furnace temperatures; a Fery radiation pyrometer; various forms of commercial pyrometers and nitrogen filled mercurial thermometers; apparatus for determining specific heat of solids at high temperatures; apparatus for comparing thermometers; electrical oven for the calibration of pyrometers by comparison with standard.

STEAM ENGINEERING.

The equipment of the steam engine laboratory consists of four 250 horse power Stirling boilers, two hand fired, two with McKenzie traveling grates and one 350 horse power Stirling boiler with Greene traveling grate; a 25 horse power Erie City internally fired boiler; a 9 and 18x24 cross-compound condensing Corliss engine with double eccentrics and reheater receiver, built by the Allis-Chalmers Co.; a 70 horse power Russel automatic high speed engine; a 300 horse power Ball and Wood direct connected engine; a 7 and 9x14 H. S. & G. cross-compound condensing engine; an 8x10 horizontal Porter steam engine; a 40 horse power Kerr steam turbine; an 8x10 Phoenix automatic steam engine; steam pumps of several types; a small vertical engine direct connected to a 72-inch exhaust fan; two Wheeler surface condensers with 100 and 400 square feet of cooling surface; a Wainwright condenser with 100 square feet of cooling surface; several injectors of different types; a Lewis transmission dynamometer; a large variety of steam, ammonia and gas engine indicators, representing all the standard makes, a recording chronograph; apparatus for testing gauges and indicators and numerous small instruments and accessories.

AUTOMOBILE ENGINEERING.

The equipment consists of a 40 horse power Halladay touring car chassis, mounted on an endless belt absorption dynamometer and fully equipped with transmission dynamometers, speed counters and optical

indicators. The apparatus includes a 35 horse power Rutenber, 4 cycle, 4 cylinder motor; a 20 horse power Continental 4 cycle, 4 cylinder motor; a 5 horse power, 2 cycle, 1 cylinder Gray motor; a complete assortment of igniters, batteries, carburetors, radiators and other automobile accessories.

REFRIGERATING ENGINEERING.

The equipment consists of a 5 ton York steam driven compressor plant and accessories. The steam is furnished by a 25 horse power, semi-portable, Erie City "Economic" internally fired boiler. Provision is made for manufacturing ice by the plate or can system. The equipment includes various appliances for measuring the heat transmission through insulating materials.

TESTING.

The equipment now in place in the mechanical laboratories permits of tests and investigations along the following lines:

Tension, crushing or transverse tests, involving loads up to 200,000 pounds on timber and metals used in construction, standard tests of building stone, cement and concrete, also rattler tests of paving brick; strength of brake beams, bolsters and other railroad appliances; torsional strength of shafting on specimens up to 1½ inches in diameter and 5 feet in length; behavior of roller, ball and sliding bearings under different loads and speeds; transmitting power and strength of belting; examinations of the physical properties of lubricating oils and greases; efficiency of bearing metals; calorific value of coal, gas and other fuels; standardization of thermometers, pyrometers and gauges; efficiency tests of gas, oil and steam engines; evaporative trials of boilers; complete tests of pumping stations, power, heating and refrigerating plants; experimental investigations of engineering problems.

PATTERN SHOP.

The equipment of the pattern shop consists of one 25-inch single surface planing machine, one 10-inch universal woodworker and jointer, one 4-inch three-side molding machine, one double-saw circular saw machine, two band-saw machines, one scroll saw machine, one vertical wood-boring machine, one mortise machine, one tenon machine, one double emery grinder, one disk grinder, one sand drum machine, two grinder-stones, two wood trimmers, thirty-two 12-inch speed lathes, one 14-inch speed lathe, five 16-inch pattern lathes, one 24-inch pattern lathe, each lathe having a case of six drawers containing complete sets of wood-turning tools. There are also eighteen double pattern makers' benches with quick acting vises and two large glue benches. Each pattern bench has personal drawers and cupboards and the latter are supplied with a full equipment of personal and general tools.

To withstand the vibration of high-speed machinery, a three-inch maple floor is laid over the usual fireproof construction. The shavings and dust from the planers and saws are forced by a fan into a special flue in the chimney.

FORGE SHOP.

The equipment of the forge shop includes 30 down-draft forges, a small hand forge, a 400-pound steam hammer, a power hammer, a punch and shear of 38 tons capacity, a coke furnace, a 20-inch drill press, a 16-inch double emery grinder and a complete set of gas furnaces for tempering, annealing, etc. Part of the forge shop is devoted to pipe fitting and is equipped with seven pipe-fitting benches, a pipe-threading machine and a large assortment of pipe-fitting tools. The exhauster and blower are driven by a 20 horse power motor, which also supplies power for a swing saw for cutting up stock.

MACHINE SHOP.

The machine shop is equipped with 17 engine lathes of different sizes; namely, two 12-inch, three 14-inch, eight 16-inch, one 22-inch, one 26-inch, three 8-inch speed lathes and one improved hand lathe, one 16-inch by 6-foot and one 16-inch by 8-foot motor driven lathes. The shop also contains two universal grinders, one 10-inch slotter, one cutter and one reamer grinder, one diamond grinder, one electrically driven center grinder, one emery grinder, one grindstone and one motor driven universal tool grinder. There are three drill presses, three milling machines, a screw machine, two shapers, a 30-inch planer, a horizontal boring mill and fifty benches and bench vises, together with a complete assortment of tools for working in iron, steel and brass. An overhead track with differential pulley and carriage is arranged to serve the heavy planer and boring mill. A gas furnace, set for brazing, soldering and tempering, completes the equipment.

FOUNDRY.

The foundry is equipped with a Whiting cupola of 1½ tons capacity per hour, a complete set of brass furnaces with forced draft, a molding press, a geared tumbler, two molding machines using stripping plates and a portable core oven. A small motor drives a double emery grinder, a 6x6 air compressor and the blower for the brass furnace. The blower for the cupola is directly belted to its own motor. A system of surface tracks and a 1-ton overhead traveling crane with pneumatic hoist serve both the cupola and brass furnaces. Snap flask and stalls and core tables are arranged along the walls before each of the windows. Truck ladles, trucks, flasks, pneumatic chippers and molder's tools complete the equipment.

INSPECTION VISITS.

Inspection visits are made under the guidance of members of the Faculty for the purpose of studying the commercial aspect of engineering problems. The following establishments are visited in the course of the year:

Chicago Avenue Pumping Station.
Thirty-ninth Street Pumping Station.
Power House, South Side Elevated Railroad.
South Chicago Works, Illinois Steel Company.
Chicago Edison Company, Fisk Street Station.
Boiler Works, John Mohr & Son.
Link Belt Machinery Company.
Northwestern Elevated Railway, Power Plant
Dearborn Drug and Chemical Company.
Kroeschell Brothers Ice Machine Company.
Consumers' Ice Company.
Underwriters' Laboratories.
Union Loop Power Plant.
Calumet Cement Works.
Mechanical Plant of the Heyworth Building.
Mechanical Plant of the First National Bank Building.
Mechanical Plant of the Railway Exchange Building.
Division Street Station of the People's Gas Light and Coke Company's Manufacturing plant.
Heating Plant of the University of Chicago.
Power Plant of Mandel Brothers' Department Store.
Mechanical Plant of the New York Life Building.
Mechanical Plant of the Hotel Vendôme.
Mechanical Plant of the Blackstone Hotel.
Mechanical Plant of the Northwestern Office Building.
Mechanical Plant of the Armour Glue Works.

II. DEPARTMENT OF ELECTRICAL ENGINEERING

ERNEST HARRISON FREEMAN, B. S., E. E.,
Professor of Electrical Engineering.

JOHN EDWIN SNOW, A. M., M. S., E. E.,
Associate Professor of Electrical Engineering.

DAVID PENN MORETON, B. S., E. E.,
Associate Professor of Electrical Engineering.

WILLIAM EDWARD BARROWS, JR., B. S., E. E.,
Assistant Professor of Electrical Engineering.

OLIVER CHARLES CLIFFORD, Ph. D.,
Assistant Professor of Electrical Engineering.

GEORGE EVERETT MARSH, B. S.,
Instructor in Electrical Engineering.

HAROLD WILLIAM NICHOLS, M. S., E. E.,
Instructor in Electrical Engineering.

The field of Electrical Engineering has become so extensive, both in scientific interest and variety of applications, that the preparation of the student intending to follow this line of work must of necessity be specialized to a certain degree. At the same time it should be kept as broad as possible by a thorough study of fundamental engineering principles.

The primary object of the course in Electrical Engineering is to develop an ability to solve electrical engineering problems from commercial as well as technical premises. It is held that this end can be attained through the study and use of a more or less specialized class of propositions and apparatus, while at the same time a familiarity is gained with the methods and machinery associated with some particular line of endeavor.

With the considerations mentioned above in view, the work in Electrical Engineering has been arranged so as to allow the student during the Senior year to choose electives pertaining to the field of his choice. The general plan of the course is to give a knowledge of the general principle of engineering as broad as is consistent with the required specialization. This is realized by an extended study of fundamental theory supplemented by abundant work in draughting room, shop and laboratory. As early as possible the student is furnished with the working tools, the mathematics and sciences, which are to be used later in the work of his profession.

In the latter part of the course, particularly during the Senior year, the work becomes more practical and specialized in nature, thus giving the student an opportunity to meet problems and overcome difficulties of a nature similar to those which he is expected to encounter later in his engineering practice.

SUBJECTS OF INSTRUCTION.

Open to students of Electrical Engineering, Hydro-Electric Engineering and Fire Protection Engineering only.

I. THEORY AND PRACTICE OF ELECTRICAL MEASUREMENTS.

Mr. Marsh.

This course lays the foundation for all later electrical engineering instruction and familiarizes the student with the physical and mathematical relations of the fundamental electrical and magnetic quantities.

The several divisions of the subject are taken up in turn and studied in detail. The application and engineering utility of the principles are clearly demonstrated, and the true significance of the topics is firmly fixed in the student's mind by a comprehensive and well related list of problems.

The theory and practice of the measurement of the electrical quantities are taken up in detail. The applicability, precision, and advantages of the various methods available for the measurement of resistance, current, potential, etc., are fully discussed. Lectures and recitations.

Text-books: Special Notes, and Reference Books.

Three hours per week during the Sophomore year of the Electrical, Hydro-Electric, and Fire Protection Engineering courses.

Prerequisite: Mathematics, Courses I and II.

II. ELECTRICAL LABORATORY, Sophomore Year.

Mr. Nichols.

This course is the laboratory accompaniment to Course I, "Theory and Practice of Electrical Measurements." A comprehensive series of laboratory exercises is provided. The measurement of electrical quantities by the various standard methods is fully investigated; the relative advantages and limitations are made clear and the student becomes familiar with the manipulation of the measuring apparatus and instruments used in electrical testing in all its branches.

Text-books: Special Notes, and Reference Books.

Three hours per week during the Sophomore year of the Electrical, Hydro-Electric, and Fire Protection Engineering courses.

III. ADVANCED ELECTRICAL AND MAGNETIC MEASUREMENTS AND THEORY OF DIRECT CURRENT DYNAMOS.

Associate Professor Moreton.

The object of this course is essentially the same as outlined for the Sophomore year. It is intended that this work shall complete, for the most part, the preliminary training whereby the student gains a working knowledge of the various electrical quantities.

The semester's work begins with a mathematical study of the ballistic galvanometer, followed by the subjects of magnetism, inductance, and capacity. The relations of these various quantities are defined, the fundamental principles involved in the methods employed in their experimental determination pointed out and their practical application discussed in detail.

During the latter part of the semester the fundamental principles involved in the dynamo are considered and their various applications used as a basis for classification and study of the several types. The characteristics of the several types of machines are studied in detail and the requirements that they must meet when in actual operation are considered.

Text-book: Special Notes and Lectures; Waldo, *Problems in Electrical Engineering.*

Four hours per week during the first semester of the Junior year.

Prerequisite: Course I.

IV. DIRECT CURRENT MACHINERY.

Associate Professor Moreton.

(a) Direct Current Motors.

The first half of the semester's work is devoted to the study of direct current motors, their characteristics under different conditions of operation, and the selection of the proper type of motor to meet given requirements. The different methods of speed control are given special consideration, also operation of generators and motors for combined output. Numerous practical problems are assigned.

Each student is given a subject which has some bearing upon general class work, and is expected to make a complete bibliography and to write a thesis of not less than three thousand words which shall be submitted for approval not later than the twelfth week of the semester.

(b) Direct Current Machinery Design.

The object of this course is to familiarize the student with the design, construction and installation of the various types of direct current machinery. To accomplish this, a series of lectures is given, based upon several text-books and brought up to date by means of

current literature and personal observation, the re-writing and filling in of notes taken by the students, and the working of problems covered by the material given in the lectures. This involves the discussion of the design, construction and the use of the various types of direct current generators and motors. The design of a dynamo or motor is completely worked out and all required design constants given. From data thus obtained each student is required to complete the numerical calculations for the design of a particular dynamo. A different problem is furnished each student. The design, construction and operation of the various direct current motors are discussed.

Text-books: Lyon, *Problems in Electrical Engineering;* Special notes, with references; S. P. Thompson, *Dynamo Design.*

Four hours per week during the second semester of the Junior year.

V. LABORATORY METHODS, Junior Year.

Associate Professor Moreton.

The laboratory experiments are discussed from the theoretical and practical standpoints. Difficulties which the students are likely to encounter in their laboratory work are given special consideration so that proper precaution will be taken in obtaining experimental data. The results obtained and errors in methods are discussed, and a comparison is made of actual and theoretical values.

Text-books: Notes and References.

One hour per week throughout the Junior year.

Prerequisite: Course III.

VI. ELECTRICAL LABORATORY, Junior Year.

Assistant Professor Barrows, Mr. Marsh, Mr. Nichols.

The Junior laboratory work follows that of the preceding year in logical order and parallels the corresponding lecture course III. The general plan is the same as that outlined for the Sophomore year. The standard methods of measuring capacity, inductance, and magnetic quanties are studied and compared in the laboratory. The advantages and limitations of the different methods are carefully noted and the relative merits of each, with respect to its practical utility are made clear to the student.

Three hours per week during the first semester of the Junior year.

Prerequisites: Courses I and II.

VII. POWER PLANTS.

Associate Professor Snow.

The subject covers the electrical equipment of the power plant, such as types of generators, converters, storage batteries, wiring systems, location and design of switchboards, low and high tension switching

arrangements and methods of control, circuit interrupting devices, lightning arresters and lightning arrester connections, instrument wiring diagrams, typical central stations and substations. The cost of the component parts of the power station, fuel, etc., and their effect on design are taken up.

Text-book: Weingreen, *Electric Power Plant Engineering.*

Two hours per week during the second semester of the Senior year of the Electrical and Chemical Engineering courses, and during the second semester of the Junior year of the Hydro-Electric Engineering course.

VIII. ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY.

Professor Freeman.

This work begins with a physical and mathematical study of the effect of the various quantities in alternating current circuits. The general plan is to convey first a mental conception of the different relations and then to show how these relations may be expressed mathematically and graphically. The symbolic method is also studied and problems are given to illustrate the use of the different methods and to familiarize the student with practical applications of alternating currents. The course includes a study of polyphase alternating currents.

The mathematical and graphical methods are next applied to the study of alternating current machines, beginning with the transformer and continuing with the alternating current generator, the synchronous motor and the synchronous converter. The operating characteristics and practical applications of these machines are also studied.

Text-book: Sheldon, *Alternating Current Machines.*

Five hours per week during first semester of the Senior year.

Prerequisites: Courses III and IV.

IX. ALTERNATING CURRENT MACHINERY AND POWER TRANSMISSION.

Professor Freeman.

The first part of this course is a continuation of the previous one and includes a study of alternating current machines such as induction motors, both singlephase and polyphase, and the commutator types of alternating current motors. The characteristics of these different motors are studied so as to show their special fitness for the various classes of service they are required to perform.

The work in transmission and distribution of electric energy consists of a study of the materials used, the determination of line constants, and the effect of these upon the character of the service and the choice of voltage and frequency. Special difficulties met with in very long and very high voltage transmission systems are also studied, as well as the modifications in the design of electrical machinery used

for this kind of electrical transmission. Problems are given requiring calculation of the various features considered in the design and operation of transmission and distribution systems.

Text-book: Bailey, *The Induction Motor,* and Special Notes.

Five hours per week during the second semester of the Senior year.

Prerequisite: Course VIII.

X. ELECTRICAL MACHINERY DESIGN.

Associate Professor Snow.

This course is intended to supplement Course IV., on Direct Current Machinery. It consists of drafting room work wherein the detail drawings are made, based upon the calculations resulting from the problems assigned in the course previously mentioned. The work is individualized, so that there is the greatest possible independence and responsibility in the application of the principles of design. A completed drawing showing all necessary details is required from each student.

Three hours per week throughout the first semester of the Senior year.

Prerequisite: Course IV.

XI. DYNAMO LABORATORY.

Associate Professor Snow, Assistant Professor Barrows, Mr. Marsh, and Mr. Nichols.

In this course, electrical machinery is studied first, with a view of grounding the student in the theory underlying its action; second, from the standpoint of design; third, from the commercial point of view. The bibliography of the various branches of the subject is given, and the student is required to do a considerable amount of reference reading. Great stress is laid on the fact that mere descriptions of method and compilation of data do not constitute a knowledge of the subject under consideration. A carefully prepared discussion dealing with the theory involved and with its practical application is demanded on each experiment previous to entering the laboratory, and this is incorporated with the experimental data and conclusions in each final report. The second semester of the Junior year is devoted to the study of direct-current, constant-potential dynamos and motors. The work of the Senior year deals with alternating-current machinery, both singlephase and polyphase, of practically all of the commercial types in use at the present time.

Chicago contains representative examples of nearly all phases of electrical manufacture and installation, and this fact is utilized to demonstrate commercial applications of principles and of machines studied in class-room and laboratory. Inspection visits are made to points in the city where problems can be studied from a practical standpoint.

Text-books: Special Notes, and References.

Three hours per week during the second semester of the Junior year and three hours per week during the first and second semesters of the Senior year.

XII. OPERATION AND TESTING OF DYNAMO ELECTRIC MACHINERY.

Associate Professor Snow.

This is a parallel course to Course XI. in dynamo laboratory practice. Methods of testing, as carried out in the laboratory, are studied in detail and results there obtained are discussed both from the standpoint of theory and design of this class of machinery, as well as the applicability and accuracy of various methods of obtaining these results. The work covers not only the tests on the machines in the laboratory, but also on those of larger sizes and of a more complicated nature such as engineers are likely to meet in commercial practice.

The operation of central station apparatus is taken up and studied both in regard to economy of operation and to methods of manipulation.

Text-books: Special Notes and References.

One hour per week throughout the Senior year.

XIII. CENTRAL STATION DESIGN.

Associate Professor Snow.

An extended study is made of the various appliances used in the equipment of a modern power plant. The instruction is given chiefly at the drafting board. The work is conducted in such a way that the student may meet and overcome the numerous problems that arise in actual engineering practice. Each student is given as a problem the design of an electric lighting or street railway power station to fulfill certain given conditions, including the price of land, cost of coal, water and the like. By means of trade catalogues and representatives of the various firms interested he selects such engines, boilers, dynamos and accessory apparatus as seem best fitted for this particular station, draws them to a scale and arranges them in the best possible position for economy of space and ease of operation. Special attention is given to the piping of the steam plant and to the electrical control of the generators, feeders, and auxiliary apparatus. In this way the student becomes familiar with the fundamental details and considerations affecting electric station design.

Six hours per week throughout the second semester of the Senior year.

ELECTIVES.

Candidates for graduation are required to take elective studies of two hours lectures and three hours laboratory per week, or the equivalent, each semester during the Senior year.

XIV. ILLUMINATING ENGINEERING (Elective).

Assistant Professor Barrows.

This course is intended to cover the production, measurement and use of light. It includes a study of the physical properties of light and its physiological, psychological and color effects. This is followed by a study of the luminous equivalent of radiation, photometric standards, units and nomenclature; photometric apparatus and methods; portable photometers and illumination measurements and surveys. The subject of illuminants includes the various types of incandescent gas and electric lamps, arc lamps, flame and luminous arc lamps, mercury vapor lamps, and the Moore tubular light. The course is concluded with a study of illumination calculations involving point and surface light sources, and a discussion of the principles of interior and street illumination.

This course is supplemented by laboratory work involving the investigation of the accuracy and sensibility of photometric devices, comparison of luminous sources, manipulation and use of the Sharp-Millar and Weber photometers, comparison of light standards, study of reflectors, investigation of the globe photometer, measurement of spherical candlepower, determination of total luminous flux by graphical methods, preliminary calculations of illumination surveys, surveys of illumination by portable photometers, investigation of the illumination of and reflection from walls and ceiling, study of the direct, semi-direct and indirect lighting systems, and the efficiency of different classes of reflectors, photometric tests of arc and vapor lamps, investigation of Talbot's law, cosine law, and law of inverse squares, investigation of Purkinje effect, the relation of flicker, intensity, and frequency of different lamps, tests of gas lamps and calorific test of gas.

Text-book: Barrows, *Light, Photometry, and Illumination,* and special notes and lectures on illuminants.

Two lectures and three hours laboratory work per week throughout the Junior or Senior year.

XV. ELECTRIC RAILWAYS (Elective).

Mr. Nichols.

This course treats of the design, construction, and operation of electric railways, from the preliminary field engineering to the final calculations of income and operating expenses. This includes a treatment of preliminary survey of the region considered, speed-time-energy curves, motor characteristics, schedules; choice of motor, acceleration, and of system; load curves, generating station, substations, distributing system, construction and operation of the road; and the financial items involved. A typical design is carried through to illustrate the methods actually employed in the design of a high speed interurban system.

In addition to the lectures the student will devote three hours per week to the design of a particular system, starting from data on the

nature of the proposed road, character of the business, etc., and will work out the electrical equipment completely.

Text-books: Special Notes and Lectures.

Two lectures and three hours drawing throughout the Senior year.

XVI. TELEPHONY (Elective).

Associate Professor Moreton.

The subject deals with the principles of telephone instruments and circuits and with the electrical transmission of sound impulses. A brief history of the earlier forms of simple telephone apparatus, including the work of Bell, Gray, and others, is presented in chronological order.

The general outline of the work consists of a detailed treatment of the transmitter and its action; single and multiple contact transmitters; solid and granular carbon electrodes; commercial types, their advantages and disadvantages in connection with local battery work; commercial types of single and bi-polar receivers, their mechanical and electrical design; types of wet and dry cells for transmitter purposes; the magneto-generator and the polarized bell or ringer and their design; the effect of the design upon the form of current wave; the automatic shunt; the hook-switch; circuits of the series and bridging types of instruments; the wiring of instruments; telephone lines; party line systems; earth currents and line disturbances; effects of induction and capacity; cross talk; small exchange systems; switchboards; types of drops and jacks; cord circuits; operator's circuit; plugs and cords; ringing and listening keys; ring-back keys; visual signals; lamp signals; self-restoring devices; transfer circuits; special operator's circuits, and all other equipment necessary for the operation of a generator call system.

The different methods of signalling are considered, followed by a study of the best arrangement of the subscriber's station as used by the leading manufacturers. The cord circuits of non-multiple boards are studied, special attention being given to the operation of the supervisory signalling apparatus and the cut-off and line relays. The various two-wire and three-wire multiple systems are studied in a regular order and comparisons made. Trunking circuits, order wire circuits, wire chief's circuits and other auxiliary circuits necessary for the operation of a large system are completely developed.

Text-book: Kempster B. Miller, *American Telephone Practice.*

Two hours per week during the first semester of the Junior or Senior year.

XVII. TELEPHONE ENGINEERING (Elective).

Associate Professor Moreton.

This course is a continuation of the course in Telephony and considers the special applications of telephones, automatic and semi-auto-

matic systems; composite lines; relations of telegraphy to telephony; duplex and multiplex telegraphy; phantom circuits; loading coils; railway composites; adaptations of one system to work with another; design of circuits for special purposes; telephone repeaters; the selenium cell; the "talking arc." Railway signals are taken up briefly so as to give the student a good knowledge of their operation.

Those problems are considered that relate to the business management of a large telephone system; organization of traffic department; distribution of load in exchanges; classification of service; study of measured service, flat-rate, and automatic pay stations; two, four, and ten party lines, local trunk and private branch exchange traffic.

Some time is devoted to circuit designing, giving the student an opportunity to fix more firmly in his mind the conventional designs and symbols used in telephone engineering.

The proper design of switchboard frames, distributing frames and supports, floor plans of exchanges, line construction, man-holes, cable ducts, cable boxes and pole line construction material are all treated according to their importance.

Text-books: Special Notes and References.

Two hours per week during the second semester of the Junior or Senior year.

XVIII. TELEPHONE LABORATORY (Elective).

Associate Professor Moreton.

The laboratory work is intended to supplement the work as outlined in the two lecture courses. It consists of experiments in the testing of various forms of transmitters and receivers; tests of induction coils and their effects upon the talking circuit; the usual causes of trouble and their remedies; splices; contacts and connections; the effect of resistance, inductance and capacity upon the transmission of speech; the construction of simple circuits, such as party lines; series and bridging lines; effect of resistance and induction upon party lines; trouble hunting; construction of simple switchboard circuits, including operator's circuit and ringing and listening keys; the ringback key; central energy apparatus; lamp signals; repeating coils; arrangement of capacity and self-induction experiments with multiple switchboard and transfer circuits; power plant tests; use of direct current; alternating current and interrupted current machines; busy tests; wire chief's work; testing and location of trouble; automatic apparatus; Strowger automatic switchboard; selectors and connectors; simultaneous telegraphy and telephony; duplex telephony; selective ringing devices for two and four party lines; special circuits. In general, it is supplementary to the work in advanced Telephony.

Text-book: Special bulletins.

Three hours per week throughout the Junior or Senior year.

XIX. APPLICATION OF VECTOR ANALYSIS (Elective).

Mr. Nichols.

A continuation of the course in the theory of the Vector Analysis. It is an introduction to the mathematical theory of Electricity and Magnetism, especially to the Maxwell Theory and its extensions; an application of the methods of the vector calculus to the solution of physical problems, for which it is especially adapted.

The treatment will involve a study of Gauss' and of Stokes' theorems and their applications, theory of the potential function, the motion of fluids, and a complete study of the Maxwell Theory, the electromagnetic theory of light, and some of the later developments due to the introduction of the electron theory.

Text-book: Coffin, *Vector Analysis*, and Special Notes.

Two hours per week during the second semester of the Junior or Senior years.

The following subjects are open to students of other departments:

XX. ELECTRICITY.

Assistant Professors Clifford and Barrows.

This course is intended to cover the elements of electrical theory essential to the development of the underlying principles of ordinary electrical machines and to the operation of such appliances, leaving out subjects of design and more technical considerations which would be of particular interest to the student making electrical engineering his chief study. The course as presented divides itself into three parts.

(a) Electrical Measurements.

The work covered in this division includes part of courses I, II and III, leaving out the more mathematical considerations. The laws of the electric and magnetic circuits are developed and applied to explain the operation of such electrical measuring instruments as are used commercially. The laboratory course includes the use and calibration of electrical instruments for resistance, current, potential, power and energy measurements.

Text-book: Timbie, *Elements of Electricity*, and Special Notes.

(b) Direct Current Machines.

This part of the course developes the theory of direct current machines, generators, and motors especially, with a view to familiarize the student with the various types of machines, the difference of design, and the effect of these differences on operation, without working out the rules governing design. Special attention is given to motors regarding speed variation and applicability to various purposes. In the laboratory the important operating characteristic of generators and

motors are obtained experimentally, the purpose being to show the differences between types of machines and to give the student a knowledge of the erection and operation of such machines.

Text-book: Sheldon, *Dynamo Electric Machinery,* and Special Notes.

(c) Alternating Currents.

Some time is given to the development of the theory of the alternating current circuit making the treatment as graphical as possible. A discussion of the theory of commercial alternating machinery follows. As in (b), the effort is to make clear the differences in construction, operation, and availability of the various types of alternators, transformers and motors. All working formulae for design are omitted. In the laboratory after introducing experiments on alternating current circuits, others on generators, transformers, and motors follow. These experiments are to show the characteristics of the various machines and to familiarize the student with connecting and operating.

Text-book: Sheldon, *Alternating Current Machinery,* and Special Notes.

Two lectures per week and three laboratory hours per week during the Senior year of the Mechanical Engineering course and of the Junior year of the Chemical Engineering course. Two lectures and three laboratory hours per week during the Senior year of Courses I., II. and III. in the Civil Engineering department. Two lectures per week during the Senior year of the Fire Protection Engineering course.

XXI. ELECTRIC WIRING AND ILLUMINATION.

Assistant Professor Barrows.

This course is intended to give to the students of *architecture* a fundamental knowledge of Ohm's law; the physical features of electrical conductors and the determination and use of their characteristics; the mechanical details of wiring construction; the location of outlets; the prevailing practice as required by the National Board of Underwriters; the study of artificial illuminants, their operation and use; and the principles of interior illumination.

Text-book: Special Notes and Lectures.

Two hours a week during the first semester of the Senior year of the course in Architecture.

THESIS.

The subject for thesis investigation will be assigned to the student by the Professor of Electrical Engineering at the beginning of the first semester. The thesis may, at the discretion of the student, involve either an original design with complete drawings and specifications, or an experimental investigation. The student must begin his preliminary work early in the first semester.

LABORATORY EQUIPMENT.

GENERAL LABORATORIES.

The general laboratories of the department of Electrical Engineering consist of a well-lighted room, 52 by 64 feet, used for general work; a laboratory for advanced electrical and magnetic measurements, and a photometric laboratory. The equipment is elaborate and the apparatus of the highest grade of excellence.

Since the units of resistance are fundamental for all electrical measurements, neither pains nor expense has been spared to secure a complete and accurate list of standards. The standard resistances have been calibrated at the Phys. Reichsanstalt, and U. S. Bureau of Standards, and range in value from 100,000 ohms down to 0.00001 ohm. Resistance boxes of various types have been provided to the extent of thirty-seven pieces.

A large number of Wheatstone bridges manufactured by representative makers in this country and Europe are available for resistance measurements. These include the slide-wire type, with Carey-Foster commutators, and plug and dial patterns.

For the accurate determination of electromotive forces and currents, several high grade potentiometers are provided.

The equipment of keys, pole-changers and commutators is very complete, comprising all standard designs and several pieces of those designs most frequently in use.

For galvanometer work there are a large number of instruments, the collection being representative of the leading types of the best makes. Special prominence is given to the use of D'Arsonval galvanometers, of which many are available.

There are at present in the photometric laboratory two Bunsen photometers, a 2½-meter photometer bar by Schmidt & Haensch, two Lummer-Brodhum boxes, a Simmance-Abady flicker screen, a Leonard-Weber photometer, a Sharp-Millar photometer, an Ulbricht globe, a Didbin Pentane standard lamp, standard Hefner lamps, and a number of special devices for handling arc and incandescent lamps.

The equipment of special apparatus for the measurement of electric and magnetic quantities, and also for the measurement of speed, time, torque, etc., is unusually extensive. It includes direct-driven secohmmeters, two variable standards of self-induction, a General Electric 3-vibrator oscillograph, special tuning forks for stroboscopic methods of measuring speed, magneto-electric tachometers of several designs, rotating contact makers for the absolute determination of capacity, a faradmeter of the tuning fork type, frequency meters, phase meters, power factor indicators, special standard wattmeters and voltmeters for alternating current working and numerous minor devices for general laboratory work.

In addition to the above a very complete calibrating table has been fitted up with standards whereby the various instruments in use in the laboratories may be checked and adjusted from time to time.

The equipment of ammeters, voltmeters and wattmeters for general laboratory use numbers about seventy-five pieces, and comprises the laboratory standard type of voltmeters and ammeters, milli-voltmeters and mil-ammeters for direct and alternating currents, and a number of wattmeters of different ranges. In addition there is a large number of voltmeters and ammeters for study and comparison, illustrating the leading systems in use for laboratory and central station practice. The collection of ampere-hour and watt-hour meters is also large and representative of the types in general use for direct and alternating currents.

A special storage bettery consisting of 60 cells of 240 ampere-hours capacity is supplied with a charging board and special commutator whereby the cells may be connected in various combinations of series-multiple as desired. Currents as high as 5,000 amperes may be obtained from this battery by means of a special water cooled rheostat. In addition to the above there is available a smaller battery of 120 cells, arranged so that different groupings may be readily made, and a battery for telephone work. The batteries are used in those experiments where constancy of voltage is required.

For the determination of dielectric strength and for calibration work there are provided a 1,500-volt motor generator set, a 600-volt dynamotor, besides a 150,000-volt and a 40,000-volt transformer. In this connection a 100,000-volt oil immersed voltmeter of Westinghouse make is available.

The equipment for magnetic testing includes special rheostats and switches used in connection with the ring method, a Ewing magnetic curve tracer, Hopkinson divided bar apparatus, Hartmann-Braun bismuth spiral permeameter, a Du Bois standard magnetic balance, an Esterline permeameter, a Grassot fluxmeter, and a Koepsel permeameter.

For controlling heavy currents there have been constructed in the shops fifteen carbon plate rheostats with capacities varying from 250 to 500 watts. In addition to these the laboratories are equipped with a number of field regulating rheostats and lamp racks specially designed for current control.

The mechanicians are constantly adding especially designed apparatus to the equipment of this department. The more important recent additions are contact makers for the study of alternating current phenomena, rotating pendulum contact devices for the study of rise and fall of currents in inductive circuits, direct-connected secohmmeters of special design, tachometers and numerous switching devices.

DYNAMO LABORATORY.

Direct current motors are represented by the following sizes and types: One 50 h. p. Northern interpole motor, one 30 h. p. Westinghouse shunt motor, two 26 h. p. Crocker-Wheeler motors and one 5 h. p. adjustable speed Northern motor, two 15 h. p. Fort Wayne back-geared series motors, two 20 h. p. Westinghouse compound motors, one 6 h. p. Stow multi-speed shunt motor, two 15 h. p. interpole motors, one adjustable speed Lincoln motor and two 7½ h. p. Holtzer-Cabot compound machines.

Of direct current dynamos there are two 15 k. w. Westinghouse, two 5 k. w. Holtzer-Cabot multipolar machine, one 5 k. w. C. & C. bipolar machine, and one 15 k. w. Sprague magnetic brake. The two 15 k. w. Westinghouse generators are direct coupled to motors and connected to a switchboard especially designed for the laboratory, allowing parallel or single operation.

Single phase alternating current machinery is represented by one 133 cycle 25 k. w. Wood alternator and one 60 cycle 45 k. w. Westinghouse alternator. Both of these are high tension and are connected to a switchboard equipped with electrically operated switch gear. In addition to these there are three smaller 60-cycle alternators. There is also provided a 15 h. p. single phase 60 cycle Wagner induction motor and two single phase Westinghouse series motors, railway type.

In polyphase machinery there are the following pieces designed for 25 cycles: One 30 k. w. Fort Wayne synchronous converter or double current generator, one 10 k. w. synchronous converter, two 10 h. p. induction motors and one 10 h. p. rotary field generator or synchronous motor. These machines are designed for both 2 and 3-phase circuits and are connected to a switchboard especially arranged for laboratory purposes. In addition to the above there are two 15 k. w. 60-cycle polyphase generators, one 5 k. w. 60-cycle synchronous converter, and one 10 k. w. 2-phase permutator. The generators are wound for 1, 2, 3 and 6-phase work and each is direct connected to a motor, so that they may be operated singly or in parallel. They can be connected to a 3-phase switchboard fully equipped with indicating and integrating wattmeters, synchroscope, power factor meter, frequency meter and the like. This board is especially designed for a study of parallel operation of alternators. Sixty-cycle machinery is further represented by a 30 k. w., 3-phase generator with exciter and Tirrill regulator.

The laboratory is provided with both open and closed coil types of direct current arc dynamos. For the study of series alternating current arc lighting there are provided a General Electric constant current transformer and a constant current regulator, together with a large number of arc lamps of the leading types.

Of transformers there is a large number of leading makes, ranging from 5 to 400 light capacity. Among these may be mentioned three

5 k. w. 25-cycle Type H. General Electric, three 5 k. w. 25-cycle Type O. D. Westinghouse, two 15 k. w. 3-phase 25-cycle General Electric transformers and a set of transformers with Scott taps for phase transformation for the study of polyphase theory and practice. Among special types is one 15 k. w. 40,000-volt built by the Lakon Company, one 25 k. w. 150,000-volt, designed and built at the Institute. Among miscellaneous pieces of apparatus might be mentioned a car lighting equipment, Cooper-Hewitt mercury converter, with complete panel, auto transformers and induction regulators.

The power for the Dynamo Laboratory is obtained from the Institute Central Station, where both direct connected and belted units aggregating 500 h. p. are available either parallel or independently.

In addition to the Dynamo Laboratory, the central station will be equipped with apparatus for a study of central station economy.

TELEPHONE LABORATORY.

The equipment for telephone engineering is extensive and the Institute mentions with gratitude that several manufacturers have made liberal donations of apparatus to the Institute for this purpose. The Stromberg-Carlson Telephone Manufacturing Company, the American Telephoning Company, the Swedish-American Company, have given a complete line of instruments, including separate details, such as generators, ringers, batteries, induction coils, drop jacks, keys, transmitters and receivers. These have been mounted upon separate wooden blocks highly finished and provided with binding posts. Several types of wall instruments, as well as desk sets, have been added from time to time. Two experimental switchboards especially designed for this laboratory have been presented by the Stromberg-Carlson Company; one consists of a fifty-drop generator call manual restoring board equipped with four pairs of cords, with corresponding keys. Special circuits in connection with this board enable tests to be made which will illustrate all of the problems usually found in the operation of a large board. The second board consists of a combination of circuits which enable it to be operated as an ordinary mechanical drop generator call, as a visual call or with lamp signals. This board can also be operated as a central energy board. The two switchboards can be operated as a multiple board in which transfer circuits are laid out by the student. A model of the "A" and "B" circuits and section of multiple board apparatus for Central Energy trunking and standard circuits have also been presented by this company. The Kellogg Switchboard and Supply Company has generously donated samples of instruments and apparatus which have been mounted upon separate bases. An extensive line of generators, receivers, transmitters and hook switches has been received.

A small power board has recently been installed which is so arranged that it can be used for practical and experimental work with telephones. This board is connected with a storage battery, a motor generator set for charging the battery, and the usual power ringing machines.

The Automatic Electric Company have given a sample switchboard representing a capacity of ten thousand lines, with types of wall instruments and desk sets.

Roth Brothers & Company have furnished a one-half h. p. ringing machine fully equipped with devices for producing every kind of signaling current known.

The Holtzer-Cabot Company have also contributed one of their well known types of ringing machines.

The Monarch Telephone Company, the Chicago Telephone Supply Company, the American Fiber and Conduit Company, the Baird Manufacturing Co., the Vote Berger Telephone Co. and others have sent samples of their products for use in the laboratory.

The Frank B. Cook Company have installed a large distributing frame equipped with all types of their well known protection devices. A liberal supply of fuses, lightning protectors, heat coils, guy clamps and other materials has been included with this installation.

The Adams-Randall Company have placed at the disposal of the Institute several of their instruments.

The Western Electric Company has contributed necessary apparatus to set up standard Bell telephone circuits, both magneto and common battery.

INSPECTION VISITS.

Numerous inspection trips are made to the various generating stations and sub-stations of the lighting, power and railway companies.

The student's attention is called to the best and most modern practice in the operation and design of such plants and systems. This enables him to correlate the theoretical training with actual engineering practice.

The following establishments are open for inspection during the college course:

Fisk Street Station, Commonwealth-Edison Company.
Quarry Street Station, Commonwealth-Edison Company.
Illinois Steel Company's Plant, South Chicago.
Northwestern Elevated Railway Plant, Fullerton Avenue.
Harrison Street Station, Chicago Edison Company.
Metropolitan Elevated Railway Plant, Throop Street.
South Side Elevated Railway Plant, 40th Street.
Aurora, Elgin and Batavia Railway, Batavia, Illinois.
Joliet Electric Light & Power Company, Joliet, Illinois.

First National Bank, Monroe and Dearborn Streets.
Marshall Field & Company, State and Randolph Streets.
State Street Substation, Chicago Edison Company.
West Madison Street Substation, Commonwealth Electric Company.
Battery Substation, Northwestern Elevated Railway Company.
Lombard Substation, Aurora, Elgin and Batavia Railway.
Maywood Substation, Aurora, Elgin and Batavia Railway.
Adams Street Substation, Chicago Edison Company.
Lockport Station, Sanitary District of Chicago.
American Electric Telephone Company.
Kellogg Switchboard & Supply Company.
Monarch Telephone Mfg. Company.
Western Electric Company.
Automatic Electric Company.
Chicago Railways Company's Shops and Substations

III. THE DEPARTMENT OF CIVIL ENGINEERING.

ALFRED EDWARD PHILLIPS, C. E., Ph. D.,
Professor of Civil Engineering.
MELVILLE BAKER WELLS, C. E.,
Associate Professor of Bridge and Structural Engineering.
HERBERT JULIUS ARMSTRONG, B. S.,
Assistant Professor of Railway Engineering.
STANLEY DEAN, B. S., C. E.,
Assistant Professor of Civil Engineering.
JOHN CORNELIUS PENN, B. S., C. E.,
Instructor in Civil Engineering.

The courses of study and practice as outlined in the following pages are parallel to the end of the Sophomore year, when specialization is permitted in structural, railway, hydraulic and sanitary engineering, and hydro-electric engineering.

The location of the Institute in Chicago enables the instructors to increase the value of their instruction by the examination and study of important structures. Lectures are given from time to time by practicing engineers of prominence in their specialty. As a condition of graduation the student is required to prepare a thesis which shall represent in part, at least, original thought and research.

The Department of Civil Engineering has established a *Summer School in Surveying,* the session to cover a period of *six weeks* of continuous field practice. The work is in charge of Instructors from the Department and includes practice in the use of instruments in measuring lines and areas; leveling; topographical surveying; city surveying, railway surveys and location.

This field practice is required of all students in the Department of Civil Engineering, and so far as possible arrangements should be made to attend the session of the Summer School in Surveying following the completion of the Freshman year. This course may also be taken by students of the other departments of the Institute, by students from other engineering schools, or by others who have had the proper preparation.

Fee for the course: $30.00 for students of the Armour Institute of Technology and $45.00 for all others not students of the Armour Institute of Technology.

Elective courses are offered as follows:

Course I. Structural Engineering.
Course II. Railway Engineering.
Course III. Hydraulic and Sanitary Engineering.
Course IV. Hydro-Electric Engineering.

SUBJECTS OF INSTRUCTION.

Open to students of the Civil Engineering Department only.

I. SURVEYING, Freshman Year.

Mr. Penn.

The work includes the study of the use of the chain and tape in measuring lines and areas, and of the theory, use and adjustments of the compass, engineer's level and transit; the use of the plane-table, solar attachment and sextant; and a study of the methods employed in farm, city, topographic, mine and hydrographic surveying, illustrated by the solution of numerous problems.

Text-book: Breed and Hosmer, *Plane Surveying.*

Recitations, three hours per week during the second semester of the Freshman year in all courses.

Prerequisite: The mathematics required for admission; see page 14.

II. TOPOGRAPHICAL SURVEYING.

Assistant Professor Armstrong.

This course includes the study of topographic, geographic and exploratory surveys; methods of securing topographic control, and the mapping of all classes of surveys, including the reduction of notes. Later in the course methods of precise surveying and geodesy are taken up, including trigonometric and precise leveling, base measurement and triangulation.

Text-book: Breed and Hosmer, *Topographic Surveying.*

Three hours per week during the second semester of the Sophomore year, in all Courses, except Course IV.

Prerequisite: Surveying.

III. RAILWAY LOCATION.

Assistant Professor Armstrong.

The class room work of the second semester of the Sophomore year covers the theory of railway curves, simple, compound and transition. It includes problems in the location of turnouts, switches, sidetracks and crossovers, and the methods of cross-sectioning and computing quantities of cut and fill.

Text-book: Nagle, *Field Manual for Engineers.*

Three hours per week during the first semester of the Sophomore year in all courses, except Course IV.

Prerequisite: Surveying.

IV. TOPOGRAPHICAL DRAWING.

Mr. Penn.

The instruction is given entirely in the drafting room and consists of practice in free-hand lettering, copying, enlarging and reducing plats, line and brush shading, tinting and practice with the pantograph.

Three hours per week during the first semester of the Sophomore year in all courses.

Prerequisite: Surveying.

V. STEREOTOMY.

Mr. Penn.

The instruction is principally confined to the drafting room. Problems are assigned, consisting of the data for buttresses, piers, abutments, wing-walls, plate-band, circular or elliptic arches, groined arches, cloistered arches, skew arches and the recessed Marseilles gate. Each student works out a complete drawing of each problem, developing the surfaces and lines of intersection and finally develops a complete pattern of a stone of the structure.

Text-book: Warren, *Stereotomy and Stone-Cutting.*

Three hours per week during the second semester of the Sophomore year in all courses.

VI. ANALYTICAL MECHANICS.

Associate Professor Wells and Assistant Professor Dean.

The work in this subject comprises the study of the composition and resolution of forces, moments, centers of gravity, moments of inertia and radii of gyration, the motion of a particle under the action of forces, impact, work, energy and power.

Text-book: Bowser, *Analytical Mechanics.*

Four hours per week during the first and second semesters of the Sophomore year in all courses.

Prerequisite: Analytical Geometry and the Elements of Calculus.

VII. STRENGTH OF MATERIALS.

Professor Phillips.

The instruction covers the derivation and use of formulæ in the dimensioning of engineering structures. Numerous problems are assigned, intended to give the student speed and facility in calculating center of gravity, moment of inertia and radius of gyration, and make him familiar with the hand-books of structural steel companies.

Text-books: *Hand-Book of the Carnegie Steel Co.;* Merriman, *Mechanics of Materials.*

Four hours per week during the second semester of the Sophomore year in all courses.

Prerequisite: Analytical Mechanics: First Semester.

VIII. APPLIED MECHANICS.

Professor Phillips.

This work consists of the application of the principles of mechanics to the stability of earthwork and the theories governing the design of foundations, dams, reservoirs, and retaining walls.

Text-book: Prelini, *Retaining Walls and Dams.*

Three hours per week during the first semester of the Junior year in all courses.

Prerequisite: Strength of Materials.

IX. STRUCTURAL DETAILS.

Associate Professor Wells.

To assist the student in designing, lectures accompanied by sketches are given upon the accepted methods of designing the details of steel structures. Attention is called to the economy of shop practice as exemplified in processes of manufacture and erection.

Text-book: Wells, *Steel Bridge Design.*

One hour per week throughout the Junior year, in all Courses.

X. HYDRAULICS.

Assistant Professor Dean.

The instruction covers the laws that govern the flow of water through orifices, over weirs and through long pipes and open channels, the pressure upon submerged surfaces, including dams and reservoirs, and the theory of the pump, turbine and ram.

Text-book: Merriman, *Hydraulics.*

Five hours per week during the first semester of the Junior year in all courses and the second semester in Course III.

Prerequisite: Analytical Mechanics: First Semester.

XI. THEORY AND PRACTICE OF CONCRETE DESIGN.

Assistant Professor Dean.

Concrete, plain and reinforced, is now so generally used in all classes of engineering structures that particular attention must be given to the principles involved in the design of beams, columns, slabs, and arches and to the application of these principles and the results of tests to the actual design and construction of engineering structures.

Text-books: Turneaure and Maurer, *Concrete Construction.*

Three hours per week during the second semester of the Junior year in all courses.

Prerequisite: Strength of Materials.

XII. RAILWAY CONSTRUCTION.

Assistant Professor Armstrong.

This course includes a general survey of the most important features of railroad construction, such as trestles, tunnels, culverts, track construction, rolling stock, etc. It is intended to constitute a general course in itself as well as a preparation for more advanced work in the Senior year.

Text-book: Webb, *Railroad Construction.*

Five hours per week during the second semester of the Junior year, in Courses I. and II.

Prerequisite: Railway Location.

XIII. STRESSES IN FRAMED STRUCTURES.

Associate Professor Wells.

The subject of framed structures covers the class room work of the analytical and graphical determination of the stresses in engineering structures, such as roof trusses, mill buildings, cranes and bridge trusses, including draw spans and cantilever trusses.

Text-books: Green, *Graphics;* Phillips, *Pamphlet: Stresses in Roof Trusses and Bridges.*

Five hours per week during the first semester of the Junior year, in all Courses and during the second semester of Courses I, II and III of the Junior year.

Prerequisite: Analytical Mechanics.

XIV. GRAPHICS.

Associate Professor Wells and Mr. Penn.

Under this heading is included the work of the drafting room in the solution of problems assigned in the classroom in connection with Stresses in Framed Structures.

Nine hours per week during the first semester of the Junior year, in all Courses, except Course IV.

Three hours per week during the first semester of the Junior year in Course IV.

Prerequisite: Stresses in Framed Structures.

XV. BRIDGE AND STRUCTURAL STEEL DESIGN.

Associate Professor Wells and Mr. Penn.

This work is carried out entirely in the drafting room and consists of the detailed design of a steel roof system or mill building, a plate girder bridge, a riveted bridge and a pin-connected bridge. The size of buildings and loading upon the trusses are given. For the bridge problems the profile of a crossing with character of possible foundations is given and the most economical arrangement of spans determined. In each problem the stresses are determined for the most economical depth of truss and the structure is designed in accordance with actual shop practice. Detail drawings are made in each case and in at least two of the problems complete shop drawings are prepared.

Six hours per week during the second semester of the Junior year in all Courses.

Nine hours per week during the second semester of the Junior year in Courses I, II, and III.

Six hours per week throughout the Senior year in Courses I and II.

Prerequisites: Strength of Materials, Stresses in Framed Structures, Graphics.

XVI. MASONRY AND REINFORCED CONCRETE CONSTRUCTION.

Assistant Professor Dean.

This subject includes the study of engineering structures in stone, concrete, and brick, and the use of limes, cements, and mortars in engineering structures.

Particular attention is given to the study of the methods and cost of concrete construction, both plain and reinforced.

Text-book: Baker, *Masonry Construction.* Lectures on Masonry Construction.

Two hours per week during the first semester of the Senior year in all courses.

Prerequisite: Theory and Practice of Concrete Design.

XVII. PRACTICAL ASTRONOMY.

Mr. Penn.

This subject includes the elements of Spherical Trigonometry and Astronomic Methods, with the determination of Time, Azimuth, Latitude and Longitude.

Text-book: Young, *Manual of Astronomy.*

Three hours per week during the first semester of the Senior year in Courses I. and II.

Prerequisite: The mathematics required for admission; see page 14.

XVIII. GEOLOGY.

Assistant Professor Armstrong.

A comprehensive study of Physiographical, Dynamical and Structural Geology. Consideration is given to topographical forms and the agencies that produce them, the relation of Geology to Topography, and the relation of Geology to water supply and earth excavation.

Text-books: Scott's *Geology.*

Three hours per week during the second semester of the Senior year in all courses.

XIX. RAILWAY ENGINEERING.

Assistant Professor Armstrong.

A detailed study of the organization and promotion of railway companies, methods of securing capital, and the laws concerning railway organization. A study of the economics of railway location, construction, and maintenance, including the economics of alignment, grades, and motive power.

A continuation of the work of the Junior year, including a more detailed study of various features of construction, such as miscellaneous railway structures, grade reduction, double tracking, yards, and terminals.

Text-books: Webb, *Economics of Railroad Construction;* Tratman, *Railway Track and Track Work.* Lectures, Current Literature, and Library References.

Three hours per week throughout the Senior year in Course II.
Prerequisite: Railway Construction.

XX. RAILWAY DRAWING.

Assistant Professor Armstrong.

The drafting room work consists in making overhaul and earthwork diagrams, designing track layouts, making estimates and bills of materials for various structures, and designing railway standards.

Three hours per week throughout the Senior year in Course II.
Prerequisite: Railway Construction.

XXI. HIGHER STRUCTURES.

Associate Professor Wells.

The instruction covers the theory of the determination of the stresses in cantilever bridges, continuous and partially continuous bridges, the theory of the suspension bridge and the theory of the arch.

Text-book: Merriman and Jacoby, *Roofs and Bridges, Part IV.*

Two hours per week throughout the Senior year in Course I.
Prerequisite: Stresses in Framed Structures.

XXII. ROADS, STREETS AND PAVEMENTS.

Assistant Professor Armstrong.

A study of the economic theory of the location and construction of country roads, the design and construction of city streets and pavements, the use of various paving materials, such as asphalt, brick, wooden block and granite.

Text-book: Byrne, *Highway Construction.*

Three hours per week during the first semester of the Senior year, in Courses I. and III.

XXIII. HYDRAULIC AND SANITARY ENGINEERING.

Professor Phillips.

(a) HYDRAULIC ENGINEERING.

Study of the sources of water supply for domestic, manufacturing, irrigation and power purposes, the sources of pollution and the processes of purification, the collection and impounding of water supplies, the design of a water supply system for a town, the quantity of water required, the pressure, the determination of the size of mains, the capacity of pumps and boilers, the design of stand pipes, tanks, reservoirs and dams.

Text-book: Folwell, *Water Supply.*

(b) SEWERAGE AND DRAINAGE.

Instruction is given in the various methods of disposing of house waste and storm water, the water-carriage system, including the separate and combined systems, and the determination of shape and

dimensions of conduits, the quantity of house flow, quantity of storm water, methods of ventilation, effect of flushing, office of manholes, lamp holes, flush tanks and flush holes, location of outfall, field work of making surveys and the various methods of sewage treatment.

Text-books: Folwell, *Sewerage;* Staley and Pierson, *Separate System of Sewerage.*

(c) House Drainage and Sanitation.

The instruction covers the proper methods of connecting a house with the street sewers, the proper size of house connections, the grade, the necessity for ventilation, the arrangement of plumbing fixtures and the drainage of foundation and subsoil.

Text-book: Notes and Lectures with problems.

The subjects a, b and c form a sequence and are taught five hours per week throughout the Senior year, in Course III.

Prerequisite: Hydraulics.

XXIV. MASONRY DESIGN.

Professor Phillips and Assistant Professor Dean.

This work includes the design of masonry structures, such as bridge piers, abutments, retaining walls and dams, and the complete design of a masonry arch and a reinforced concrete arch.

Three hours per week during the first semester of the Senior year in all Courses, and three hours during the second semester in Courses I. and II.

XXV. HYDRAULIC DESIGN.

Professor Phillips and Assistant Professor Dean.

This work in relation to Hydraulic and Sanitary Engineering consists of the preparation of plans and specifications for the water supply system or sewer system for a town, from surveys and notes taken in the field, and includes the design of water tower upon steel trestle and masonry.

In relation to Hydro-Electric engineering the work consists of the design of canals, penstocks, surge tank, forebay, intake, power house and other engineering structures included in water power development.

Three hours per week during the second semester of the Senior year in Courses III. and IV.

XXVI. WATER POWER ENGINEERING AND TOPOGRAPHICAL SURVEYING.

Assistant Professor Dean.

A study is made of the various civil and hydraulic engineering features incident to the investigation, design and construction of a hydro-electric power plant, including rainfall, evaporation, runoff, storage, the theory of turbines and governors, various types of development and plant testing.

Topographical surveying as applied to drainage areas, storage reservoirs, power development sites and detailed surveys for canal, pipe line and transmission line location, etc., are studied in this course.

Text-book: Mead, *Water Power Engineering.*

Five hours per week during the second semester of the Junior year, in Course IV.

The following subjects are given to students of other departments:

XXVII. SURVEYING.

Assistant Professor Armstrong, Mr. Penn.

The instruction is given by lectures upon the use of the chain or tape in measuring lines and areas, the use, care and adjustment of the wye-level, the compass and the transit. As soon as the weather permits the class is divided into field parties and practice is given in the field in the use of the several classes of instruments.

One lecture and four hours field practice per week during the second semester of the Senior year of the Mechanical and Electrical Engineering Courses.

XXVIII. ENGINEERING CONTRACTS AND SPECIFICATIONS.

Professor Phillips.

Text-book: Tucker, *Engineering Contracts.*

Two hours per week during the second semester of the Senior year of the Civil, Mechanical, and Fire Protection Engineering courses.

XXIX. REINFORCED CONCRETE DESIGN.

Assistant Professor Dean.

The instruction covers the principles involved in the design of reinforced concrete slabs, beams, columns, footings, walls, etc., and the application of these principles and the results of tests to the design of buildings.

Text-book: Turneaure and Maurer: *Principles of Reinforced Concrete Construction.*

Two hours per week during the first semester of the Senior year of the Architectural course.

Prerequisite: Strength of Materials.

THESIS.

The subject for thesis investigation will be assigned to the student by the Professor of Civil Engineering, *four* weeks before the close of the first semester. The Thesis may, at the discretion of the student, involve either an original design with complete drawings and specifications, or an experimental investigation. The student is strongly advised to begin his preliminary work early in the second semester.

AERONAUTICS.

The rapid development of aerial navigation has led the Institute to offer instruction in the more important branches of this subject. The object of the course is to prepare students for experimental and practical work in aeronautics.

The elements of what is known of the scientific principles upon which the art of flying is based are taught. Students are made acquainted with the work and results of the principal experimenters; and also with the methods of construction now used in successful air ships and aeroplanes, including motors. These courses are elective and open to Juniors and Seniors of all departments.

SUBJECTS OF INSTRUCTION.

I. AERODYNAMICS.

Associate Professor Wells.

The work in this subject includes the study of fluid resistance, stream line forms, the economics of flight, the theory and efficiency of the screw propeller, and experimental aerodynamics. Published accounts of experiments, including the latest available, are drawn upon for data on which to base mathematical studies of the problems of flight.

Text-book: Lanchester, *Aerial Flight, Vol. I. Aerodynamics,* supplemented with lectures.

Two hours per week during the second semester of the Junior year.

II. AERONAUTICAL DESIGNING.

Associate Professor Wells.

The studies include the stresses in the principal types of balloons, air ships, and aeroplanes now in use; and the designing and detailing of these structures.

Lectures with problems assigned for solution by the students.

Two hours per week during the first semester of the Senior year.

III. GAS ENGINES.

Associate Professor Frith.

Elementary theory, construction, and practical working of light weight gas engines.

Two hours per week during the second semester of the Senior year.

EQUIPMENT OF DEPARTMENT OF CIVIL ENGINEERING.

The Institute is well equipped with engineering field instruments, comprising twenty-six complete outfits of transits and levels by the following well-known makers: Keuffel & Esser, C. L. Berger & Son, Buff

& Buff Manufacturing Company, Heller & Brightly, F. E. Brandis Sons Company, and Bausch & Lomb Co. Besides the above, the Institute possesses solar attachments, plane-tables, sextant, current meter with electrical recording apparatus, compass, large pantograph, planimeter, aneroid barometer, heliograph outfit for two stations, range finder, Thacher slide rule and Fuller slide rule. The transits and levels are all equipped with fixed stadia wires and the equipment includes telemeter rods, Philadelphia rods, target rods, chains, tapes and small instruments.

The Institute has purchased an Altitude-Azimuth instrument, designed and built by F. E. Brandis Sons & Company. The horizontal circle is 12 inches diameter and the vertical circle 10 inches diameter and each reads by microscope micrometers to single seconds. The telescope has a magnifying power of 60 diameters.

A precise Geodetic level by the Bausch and Lomb-Saegmuller Co., Rochester, N. Y., has been added to the equipment of the department.

The Institute is well supplied with shop drawings of bridges, plate girders and roof trusses, plans for sewer and water works systems, streets and pavements.

The equipment now in place permits of tests and investigations along the following lines:

The determination of lines, grades and levels; testing and adjustment of surveying instruments; measurement of areas and distances; surveys for sewers, water mains and streets, with platting of maps.

INSPECTION VISITS.

The following plants and engineering structures are visited and inspected in the course of the year by the students of the Civil Engineering Department:

Illinois Steel Company's Steel Plant, Buffington, Ind.
Chicago Ship Building Plant, South Chicago.
Chisholm, Boyd & White, Manufacturers of Brick Making Machinery.
Illinois Telephone and Telegraph Company's Tunnels.
Fourteenth Street Pumping Station.
Chicago Avenue Pumping Station.
Central Park Pumping Station.
Chicago Municipal Museum.
Pumping Station, 39th Street Intercepting Sewer.
Lassig Plant, American Bridge Company.
Chicago Bridge & Iron Works.
Illinois Steel Company.
Numerous Bridges completed and in process of erection.

IV. THE DEPARTMENT OF CHEMICAL ENGINEERING.

HARRY MCCORMACK, M. S.,
Professor of Chemical Engineering.

BENJAMIN BALL FREUD, B. S.,
Associate Professor of Organic Chemistry.

CHARLES AUSTIN TIBBALS, Ph. D.,
Associate Professor of Analytical Chemistry.

EUGENE EDWARD GILL, Ph. D.,
Assistant Professor of General Chemistry.

EARL WATSON MCMULLEN, B. S.,
Instructor in Industrial Chemistry.

HARRIE BRIDGMAN PULSIFER, S. B.,
Instructor in Metallurgy.

ALFRED ERNEST DEAN,
Curator of Chemical Laboratories.

The object of this course is to qualify young men for the management of those industries which depend on chemical processes. The Chemical Engineer should be thoroughly versed in the theories and various analytical processes of chemistry. He should be able to design and manage the plant and conduct the various steps in the manufacture of industrial products. Careful training is therefore given in designing, mathematics, mechanics and electricity, so that the student becomes familiar with the appliances, machinery and power generating apparatus of the modern industrial plant.

During the first two years of the course in Chemical Engineering the general principles of chemistry and methods of analysis are studied. The last two years are spent in a study of metallurgy, industrial chemistry and theoretical chemistry. No courses in special methods of analysis are given during the regular course, but a good working knowledge is acquired in assaying, iron and steel analysis, water and food analysis, gas and fuel analysis, bacteriology and applied microscopy in connection with the laboratory work in industrial chemistry. The courses in special methods of analysis will be offered also during each summer session.

SUBJECTS OF INSTRUCTION.

I. QUALITATIVE CHEMISTRY.

Associate Professor Tibbals, Assistant Professor Gill.

This course includes a thorough review of the chemistry of the non-metallic elements, from the standpoint of the Periodic Law, espe-

cial attention being devoted to fundamental laws and theories. The metallic elements are studied from the standpoint of the analytical classification, and the laboratory work consists of the systematic study of the reactions, separation and identification of the metals, and of the more common inorganic acids.

Prerequisite: General Chemistry.

Text-book: Smith, *General Chemistry for Colleges;* A. A. Noyes, *Qualitative Analysis.*

Three lectures, two recitations and three hours laboratory work per week during the first semester of the Freshman year in all courses except Architecture.

II. QUANTITATIVE CHEMISTRY.

Associate Professor Tibbals, Assistant Professor Gill.

The lectures take up in detail the chemistry of the analytical reactions, separations and identifications. The modern ideas of solutions and equilibrium are developed and their applications to analytical chemistry are discussed.

The laboratory work consists of selected reactions and separations that enable the student to do intelligent analytical work based on the scientific principles developed in the lectures. Sufficient practice in the analysis of materials, of graded complexity, is given. The work includes the gravimetric estimation of chlorine, iron, and sulphur; the calibration of measuring vessels, the preparation of a standard acid, base, of permanganate and bichromate solutions, of an iodine solution and practice with each.

Text-books: Talbot, *Quantitative Analysis.*

Two lectures and six hours' laboratory work per week during the second semester of the Freshman year in all courses except Architecture.

III. QUANTITATIVE CHEMISTRY, ADVANCED.

Associate Professor Tibbals.

A continuation of Course II, including the analysis of substances of greater complexity, such as dolomites, iron, lead, zinc and copper ores, feldspars and various metallurgical products.

Text-book: Treadwell, *Analytical Chemistry, Vol. II.*

One lecture and six hours' laboratory work per week during the entire Sophomore year of the Chemical Engineering course.

IV. ORGANIC CHEMISTRY.

(a) Lectures.

Associate Professor Freud.

The lecture work is divided into two parts; the first covering the aliphatic, the second the aromatic series. The general principles and theories of organic chemistry, the methods of preparation, and the reactions of typical bodies are studied in detail, particularly in the light of their interrelationships. Particular compounds which are of theoretical or technical importance are also studied in detail.

The work involves a study of the hydrocarbons, including petroleum and its products; the alcohols; the oils and fatty acids; the ethers; the ethereal salts, including soaps and perfumes; the aldehydes; the carbohydrates, including the glucoses, the higher sugars, the starches, cellulose, and cellulose derivatives; and the nitrogen compounds, including the aniline dyes, alkaloids, and albumins. The needs and products of manufacturing chemistry are kept in view along with the fundamental organic processes having general application.

Text-book: J. B. Cohen, *Theoretical Organic Chemistry.*

Three lectures per week during the Sophomore year of the Chemical Engineering course.

(b) Laboratory.

Associate Professor Freud.

The preparations that are made in this course are selected to illustrate as many of the operations and as much of the apparatus used in organic work as possible. Preparations involving the various kinds of distillations, extractions, and the various methods of crystallization are performed. General reactions, such as oxidation, reduction, nitration, saponification, and esterification, are performed. Thirty preparations are made, most of which belong to the benzene series. They range in complexity from nitro-benzene to the dyestuffs. A complete record and discussion of each preparation is required. Much of the laboratory instruction is personal.

Text-book: J. B. Cohen, *Practical Organic Chemistry for Advanced Students.*

Two consecutive periods of three hours each per week during the first semester of the Sophomore year of the Chemical Engineering course.

(c) Minor Course.

Lectures and Laboratory.

Associate Professor Freud.

The lectures cover the general principles of organic chemistry rather briefly. All of the typical compounds are studied in regard to their

preparation and their properties. As many specific compounds are studied as time permits.

The laboratory work consists of the preparation of fifteen compounds. These are selected to illustrate as many operations, and reactions, and at the same time as many different types of bodies as possible.

Text-book: Moore, *Outlines of Organic Chemistry.* Laboratory Manual; Mimeographed Directions.

Two lecture hours per week through the Sophomore year of the Fire Protection Engineering Course. One laboratory period of three hours, for the first semester of the Sophomore year of the Fire Protection Engineering Course.

V. INDUSTRIAL CHEMISTRY. (Junior.)

(a) Lectures.

Professor McCormack.

This course consists of a series of lectures and recitations upon the more important technical inorganic chemical operations, exclusive of those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes.

A critical study is also made of some of the more important applications of chemistry in manufacturing processes, such as the production of acids, alkalies, fertilizers, cement, lime, glass, pigments, chlorine and bleaching powder.

Considerable attention is paid to industrial fuels and to the purification of water for sanitary and boiler purposes. Many visits are made to various factories where these operations are being conducted and each student is expected to furnish a comprehensive report on the industry visited.

Text-book: Thorp, *Outlines of Industrial Chemistry.*

The text is supplemented by assigned readings from various sources.

Three lectures per week during the Junior year in the Chemical course.

(b) Laboratory.

Professor McCormack and Mr. McMullen.

This course accompanies the lecture-course V and embodies the preparation and purification of chemical products on a scale sufficiently large to afford data for determining with considerable accuracy the factors and conditions underlying the economy of the process employed. Each series of preparations made by the students involves a problem of practical importance for the solution of which the necessary data has

been secured from experimental work with such typical forms of apparatus as the filter press, suction and bag filter, centrifugal machine, or various types of furnaces and burners, steam-heated kettles and coils, typical dryers, etc.

The student thus obtains an insight into the method of attacking industrial chemical problems; he acquires a knowledge of the chemical and physical properties of the substances he handles and of the difficulties of manipulation in large scale work. The course is accompanied by sufficient analytical work to give a close check on the manufactured products.

This analytical work includes the technical analysis of acids, alkalies, cements, paints, bleaching powder, glass, etc., as well as the testing of various chemical reagents for purity.

Six hours per week during the Junior year in the Chemical Engineering course.

(c) Minor Course.

Professor McCormack and Mr. McMullen.

The lectures cover the theories of chemical manufacturing, the materials of construction suitable for chemical plants, and the arrangement of such plants. Considerable attention is paid to the question of the proper arrangement of chemical plants to reduce the hazard from explosives and combustion. A brief survey is taken of the more important chemical industries such as acid, alkali, fertilizer and cement manufacture.

The organic chemical industries are also dwelt upon such as the industries based on constructive distillation, the industries of the oils and fats, varnish making, textile industries and the fermentation industries.

Three lecture hours per week through the Junior year on the Fire Protection Engineering course; two laboratory periods of three hours each through the same year and course.

VI. METALLURGY. (Junior.)

(a) Lectures.

Mr. Pulsifer.

The course consists of lectures on the metallurgy of iron and steel. During the first semester the study is about the ore supply, the production of pig iron and the manufacture of cast iron, malleable iron and wrought iron. Considerable time is devoted to thorough study of the chemistry of each process as well as to the physical properties and constitution at each stage. Attention is given to the salient industrial features. The second semester is assigned to the production, properties and use of steel. The development of the industry is followed, its present status criticised; the manufacture of the products is considered with particular reference to the chemical changes while equal attention

is devoted to the physical results attained. Opportunity is given to visit plants and observe the operation of blast furnaces and the handling of materials; the production of steel in converters and open hearth furnaces; the casting and annealing of materials and the working of mills.

Text-book: Stoughton, *The Metallurgy of Iron and Steel.*

Two hours per week during the Junior year in the Chemical Engineering course.

(b) LABORATORY.

Mr. Pulsifer.

The laboratory work is closely related to the class room work and as far as possible the student carries out in practice the operations discussed in class. Favorable arrangements with foundries, blast furnaces and steel plants enable the student to become familiar with the industry.

Standard and rapid methods for the analysis of iron and steel products, fuels, fluxes and slags are taught. Practice is also given in the use of the Pitot tube in the measuring of blast velocity, in the use of various pyrometers in measuring furnace temperatures, in the analysis of gases, in the heat treatment of steels and in the preparation of surfaces and the determination of structure by use of the microscope.

Text-books: Howe, *Metallurgical Laboratory Notes.*

Three hours per week during the Junior year of the Chemical Engineering course.

VII. INDUSTRIAL CHEMISTRY. (Senior.)

(a) LECTURES.

Professor McCormack.

A continuation of Course V. The industries covered are principally wood, coal, tar and petroleum distillation, gas manufacture, soap and glycerine making, industries of the oils and waxes, cane and beet sugar manufacture, starch and glucose, fermentation industries, textile industries, dyes and dye stuffs, leather and glue manufacture and the manufacture and preservation of foods and food products.

Practically all these industries are carried on within easy reach of the class room and much of the students' information comes from the men actually carrying on the industry.

One-half day each week is usually spent in visiting some manufacturing establishment; a written report is then required which embodies all the information gained by the student from lectures, from reading or from the visit.

Three lectures per week throughout the Senior year of the Chemical Engineering course.

(b) Laboratory.

Professor McCormack and Mr. McMullen.

A continuation of the laboratory course given during the Junior year. Several of the more important organic chemical industries, such as wood distillation with recovery of by-products, refining of crude petroleum, manufacture of soap with glycerine recovery, varnish making, sugar from both beet and cane, dyeing and bleaching textile fibers, and paper making, are taken up in considerable detail. Each one is carried on from beginning to end in the laboratory. Control analyses are made during the process. The raw and finished products are also analyzed. Reports containing full data are required. The analyses for these reports necessitate considerable commercial organic work which is augmented by a study of the methods for food analysis during the year. From the problems brought up in this work, the subject for the thesis is chosen.

Nine hours per week during the first semester, six hours per week during the second semester of the Senior year in the Chemical Engineering Course.

VIII. METALLURGY OF NON-FERROUS METALS. (Senior.)

(a) Lectures.

Mr. Pulsifer.

This course of seventy lectures extends throughout the fourth year. The first semester is devoted to the metallurgy of copper and lead and of gold and silver, so far as related to copper and lead extraction. The processes for extracting lead and copper from their ores and for refining them are treated in detail. Particular attention is paid to roasting and smelting practice which may be common to all metals. Much stress is laid on the chemical and thermochemical principles involved in these operations. The second semester deals with the metallurgy of gold, silver, zinc and aluminum in detail and the minor metals, nickel, antimony, tin, cobalt, arsenic, mercury and bismuth, are discussed briefly. Considerable time is spent on recent practice in the metallurgy of the important metals; such as cyaniding gold ores and the electro and electrothermic processes applied to aluminum, zinc and nickel ores.

Text-book: Schnabel, *Handbook of Metallurgy.*

Two hours per week throughout the Senior year of the Chemical Engineering course.

(b) Laboratory.

Mr. Pulsifer.

A continuation of the work of the Junior year, with special application to the smelting and lixiviation processes as applied to copper, lead, gold, silver and zinc ores. Included in this course will be the methods

used in the assay of the ores of the various metals, both by fire and by wet methods; also a study of the composition, melting points and specific heats of various slags produced in metallurgical operations.

Laboratory tests are also conducted on crushing, grinding, roasting, cyaniding, etc., of various ores. These tests involve the determination of efficiency both of the machinery and of the process employed.

Four hours laboratory work throughout the year.

IX. ENGINEERING CHEMISTRY AND METALLURGY. (Elective.)

Associate Professor Freud.

Those problems are treated which most commonly appeal to an engineer for solution from a chemical standpoint. The principal subjects dealt with in the lectures are: Boiler feed water, the occurrence, nature and prevention of boiler scale; the origin, uses, analysis and valuation of the various solid and liquid fuels; the manufacture, uses and analysis of the various fuel gases; the sources, preparations, properties and engineering tests of lubricating oils, the metallurgy of iron and steel, the composition and properties of the chief alloys; and the chemistry of cement.

No text-books are used. The work is given by lectures.

Three hours per week during the second semester of the Junior year of the Mechanical and Electrical Engineering courses.

X. WATER AND SEWAGE.

Mr. McMullen.

The course will consist of lectures and laboratory work upon the examination of water for potable and industrial purposes. The subjects considered are the source and impurities of potable supplies, their chemical and bacteriological analyses and inferences to be drawn therefrom, methods of water purification and tests of the same. Consideration is also given to the nature and analysis of sewage and its treatment by chemical and bacterial processes.

Text-books: Mason, *Examination of Water;* Rideal, *Sewage;* Prescott & Winslow, *Elements of Water Bacteriology.*

Four hours per week during the first semester of the Senior year of the Civil Engineering Course III.

XI. BACTERIOLOGY AND APPLIED MICROSCOPY.

Mr. McMullen.

The instruction consists of lectures, recitations and laboratory work in general bacteriology, considered from the sanitary and industrial standpoint, the medical aspect being for the most part omitted except when essential to general theories. The course includes the preparation of culture media, principles of sterilization and disinfection, cultural and microscopic examination of bacteria, plating, isolation of distinct

species, method for examination of milk, air and water and the relation of micro organisms to industrial processes, such as brewing, vinegar making, dairying, tanning, and food preservation.

Four hours per week during the second semester of the Senior year of the Civil Engineering Course III.

XII. PHYSICAL CHEMISTRY.

Associate Professor Freud.

The principles of Physical Chemistry are studied in detail. Particular emphasis is laid on the applications of these principles.

The subjects covered are the properties of gases, liquids, solids, and solutions; the theories concerning the molecular and atomic conditions; the electrolytic theory; the law of mass action and its application to chemical statics and dynamics. The relationship between energy changes and chemical reactions are fully considered, except those involving electrical changes, which are considered in another course. While the course is theoretical, applications of the ideas are constantly emphasized.

Text-book: Jones, *Elements of Physical Chemistry.*

Three hours per week during the first semester of the Senior year of the Chemical Engineering course.

XIII. ELECTRO-CHEMISTRY.

Associate Professor Freud.

A general course, embracing the study in class room and laboratory of the principles involved in the application of electricity to chemistry, and the adoption of those principles in Electro-Chemical Technology and in Metallurgy.

Prerequisite: Physical Chemistry.

Text-book: Le Blanc, *Electro-Chemistry;* Thompson, *Applied Electro-chemistry.*

Two lectures per week and four hours of laboratory work per week during the second semester of the Senior year of the Chemical Engineering course, and elective for the students of the Electrical Engineering course.

XIV. CHEMICAL HAZARDS.

Associate Professor Freud.

The subject of chemistry is reviewed from the standpoint of the ability of bodies, reactions, and operations to produce or promote conflagrations.

Lectures.

Two hours per week during the second semester of the Junior year of the Fire Protection Engineering course.

XV. ELEMENTARY CHEMISTRY.

Assistant Professor Gill.

This course covers the requirements for admission to the College of Engineering.

Five lectures and four laboratory hours per week.

Text-books: McPherson and Henderson, *Elementary Study of Chemistry;* McPherson and Henderson, *Exercises in Chemistry.*

THESIS.

During the course in Industrial Chemistry each student will select one of the problems in Organic or Inorganic Industrial Chemistry, Metallurgy or Industrial Electro-Chemistry, which is to be written up fully. This report will constitute his thesis.

EQUIPMENT.

The Chemical Laboratories are provided with a complete stock of all necessary glass, porcelain, platinum and other metal ware. Each student is provided with a locker containing the apparatus necessary for his work. Special apparatus is at hand for gas, fuel, water, oil, iron and food analysis and the equipment includes the necessary microscopes, incubators and sterilizers for bacteriological work. The electro-chemical laboratory is well equipped with standard Weston measuring instruments, a large storage battery, and the apparatus necessary for laboratory work in applied and theoretical electro-chemistry.

The laboratory for metallurgical operations is fireproof throughout, having concrete floor and ore bins, and metal cupboards, benches, etc. It is equipped with an ample number of pot furnaces, muffles for assaying, and a large gas-fired oven furnace for roasting ores, etc. These are supplied with compressed air from the industrial laboratory.

Electrical furnaces, both of the carbon resistance type, and those with metal resistance for lower temperatures, are provided in sufficient size and number to carry on experimental work requiring high temperatures. Among these furnaces are one Hoskins resistance crucible furnace, and one resistance muffle furnace of the same make.

Suitable pyrometers are provided for measuring any temperature from zero to 3,600 centigrade. All of the better known types of instruments are represented in this collection.

The laboratory for industrial chemistry has been rearranged during the past year. All parts of the laboratory are now provided with compressed air, wet and dry vacuum, live and exhaust steam. All of this piping is carried in gutters in the floor so that it is readily accessible. The equipment in this laboratory includes one single effect evaporator of cast iron; a double effect evaporator of copper; a copper vacuum pan; a number of steam jacketed kettles of copper, cast iron,

and enameled cast iron. There is also a filter press with Monte-Jus, a ten inch centrifuge for drying crystalline salts, and a large centrifugal machine for settling precipitates.

These is a complete outfit for crushing and grinding, consisting of a jaw crusher, steel rolls, disc pulverizer, a ball mill, and a porcelain-stone paint mill. There is a large drier of a capacity of 250 pounds per hour, and a small vacuum drier for experimental work. Much special apparatus is designed and built as occasion demands.

The laboratory for industrial chemistry, as will be noted from the above, is equipped on such a scale that it is possible to carry on all kinds of chemical manufacturing operations on a scale of sufficient dimensions to make them comparable with actual factory operations.

INSPECTION VISITS.

The following manufacturing plants are usually visited during the year:

Albert Schwill Malting Company.
Allis-Chalmers Company.
Armour & Company, Fertilizer Works.
" " Glue Works.
" " Glycerine Works.
" " Soap Works.
Barrett Manufacturing Company.
By-Products Coke Company.
Carter White Lead Company.
Chicago Carbonic Company.
Crane Company Malleable Foundry.
Corn Products Company.
Columbia Tool Steel Company.
Grasselli Chemical Company.
Great Western Smelting and Refining Company.
Hammond Distilling Company.
Heath and Milligan Paint Company.
Illinois Steel Company, South Works.
Iroquois Iron Company, Blast Furnaces.
Matthison Hegler Zinc Company, La Salle, Ill.
Murphy Varnish Company.
National White Lead Works.
Schoenhofen Brewing Company.
Senour Paint Manufacturing Company.
Sheldon-Foster Glass Company.
Simonds Saw Company.
Standard Oil Company, Refinery.
Universal Gas Company.
Wahl and Henius Institute of Fermentology.

V. THE DEPARTMENT OF FIRE PROTECTION ENGINEERING.

FITZHUGH TAYLOR, B. S.,
Professor of Fire Protection Engineering.
JOSEPH BERNARD FINNEGAN, B. S.,
Associate Professor of Fire Protection Engineering.

The City of Chicago offers exceptional advantages for the study of problems involved in protection against fire loss. The Underwriters' Laboratories, conducted and maintained by the stock fire insurance companies of the country, are situated here and have offered their facilities for experimental and research work, co-operating with the Institute in making this course efficient both theoretically and practically. The general engineering equipment of the Institute and the advantages offered by the use of the Underwriters' Laboratories insure a broad and comprehensive course of study, fitting young men for expert work in the fire insurance field, with municipalities, corporations and manufacturing companies.

The problem of reduction of the large losses by fire that occur annually is one that has not been regarded as capable of solution until comparatively recent years. Fire insurance, while it may indemnify the property owner to the extent of the actual market value of the property destroyed by fire, can not repay him for the many indirect losses which are attendant upon the fire, while the delay incident to adjusting and collecting his claims for loss may seriously interfere with the re-establishment of his credit. Gradually, however, it is being recognized that expenditures incurred in securing excellence in design and construction and adequate protective equipment throughout the premises are a good investment, because the increased cost may be saved in a few years by a reduction in the rates of insurance. The property owner also has the benefit of a larger measure of security against the interruption of his business.

The reduction of the fire hazard in the various forms in which it appears in practice necessitates careful study and intelligent application of means of protection. Failure of inadequate protective measures has in more than one instance resulted in loss of the investment for protection and in the destruction of the property for the safeguarding of which it was originally expended.

The curriculum of the course includes the fundamental subjects, such as mathematics, physics, electricity and applied mechanics, which are necessary as a foundation for any engineering training. Particular attention is given to the study of industrial and engineering chemistry, and a series of thorough courses in these subjects extends throughout the first three years. The purely professional work of the department

is given in the third and fourth years and begins with a careful study of types of building construction and general practice in the application of protective measures. A critical examination is made of Underwriters' Requirements, and those pertaining to field work are illustrated by field inspections conducted by a competent instructor experienced in inspection work. A study is made of the various rating schedules in use in different parts of the country and practical application of these schedules is made to the mercantile, manufacturing and special hazard risks for which they are designed. The work is extended to cover buildings in course of construction as well as finished and occupied premises, and includes attention to faults of design, structural defects, installation and maintenance of fire stops and protective equipment.

The laboratory work of the department is carried throughout the Junior and Senior years of the course and is supplemented from time to time by outside tests of steam and electric pumping machinery and other apparatus embodied in private equipments. Thus the student is familiarized with correct and faulty construction and installation of hazardous and protective equipment and apparatus. The work is planned to include demonstration of practical test methods for use in the field, laboratory and shop.

SUBJECTS OF INSTRUCTION.

Open to students of the Fire Protection Engineering Department only.

I. FIRE PROTECTION ENGINEERING.

Professor Taylor, Associate Professor Finnegan.

A course of lectures supplemented by experimental investigations in the laboratories. The work in the lecture rooms covers common hazards and their treatment, modern methods of fire protection and extinction, public and private fire departments and fire apparatus, safeguards in construction and equipment of buildings, town and private water supplies.

The time assigned to laboratory work is devoted to practical hydraulic measurements and experimental study of retardant materials and protective appliances and equipments, including chemical extinguishers and engines, fire hose, fire pumps, hydrants, automatic sprinkler apparatus, fire nozzles, fire doors, shutters and other fire stops. Certain hazardous devices commonly found in the field, such as electrical appliances and fittings and acetylene and petroleum apparatus, also receive laboratory treatment.

During the greater part of the second semester of the Senior year, the time is devoted to practical inspection of special hazard and other risks, and, when practicable, of fireproof buildings in course of construction.

Two lectures and six laboratory hours per week throughout the Junior year, and six laboratory and inspection hours per week throughout the Senior year.

Prerequisites: Sophomore Physics; Theory and Practice of Electrical Measurements; Sophomore Electrical Laboratory; Analytical Mechanics; Machine Tool Work.

To BE PARALLELED BY: Junior Laboratory Physics; Mechanics of Engineering.

II. UNDERWRITERS' REQUIREMENTS.

Associate Professor Finnegan.

A detailed study of underwriters' specifications and requirements, construction of buildings and the construction and installation of the various classes of apparatus which have a bearing upon the fire hazard.

Three hours per week during the first semester and one hour during the second semester of the Senior year.

Prerequisite: Junior Fire Protection Engineering.

III. SPECIAL HAZARDS.

Associate Professor Finnegan.

This course deals with the various classes of risks which require special treatment, such as woodworkers, metalworkers, textile mills, theatres, breweries, distilleries, paper mills, celluloid works, chemical works, candy factories, paint and varnish works, grain elevators, car houses, shoe factories, dyeing and cleaning establishments, cold storage plants, etc., with special reference to inspection methods.

Three hours per week during the first semester of the Senior year.

Prerequisites: All Freshman, Sophomore and Junior Chemistry; Junior Fire Protection Engineering.

To BE PARALLELED BY: Chemical Hazards.

IV. INSURANCE PRACTICE AND SCHEDULE RATING.

Associate Professor Finnegan.

Fire insurance companies and fire insurance organizations have been responsible for most of the work that has been done on problems of fire protection.

This course treats of the history of fire insurance; the economic aspects of the business; the relation of insurance organizations to the state; the Valued Policy Law and the taxation of insurance companies. The three types of insurance organizations, stock companies, mutual companies and Lloyds, are discussed in detail. The nature and functions of rating and inspection bureaus and other associations of companies or company representatives are explained. The discussion of companies and associations covers the duties of the various officers and employes.

A portion of the course is devoted to a discussion of insurance law, with particular reference to its bearing upon policies, forms and adjustments. The important principle of Co-insurance is carefully explained, as are also the Mortgagee, Pro Rata, Percentage Value, Percentage Loss and Consequential Loss clauses.

The latter portion of the course is devoted to a study of the Dean Analytic Schedule, the Universal Mercantile Schedule, and typical special schedules now in use for rating manufacturing risks.

The subject of rates involves a treatment of the mathematics of fire insurance, and includes a discussion of loss ratio, expense ratio, commissions, reserve and surplus.

Three hours per week throughout the first semester of the Senior year.

V. ELECTRICAL MACHINERY.

Professor Taylor.

This course is designed to cover the principles underlying dynamo-electric machinery. Generating apparatus of various types is studied from theoretical and practical viewpoints, leading to familiarity with motors and a consideration of their application to various classes of service. Later on, alternating current apparatus is considered in accordance with the same general plan. The detailed work of the course includes speed and voltage relations; armature reaction and its effects; various methods of determining efficiency; characteristic curves and their interpretation; study of switchboard apparatus; determination of power factor; study of wave form. Characteristics of the various types of generators and transforming apparatus are studied, with a view of bringing out the effect of design upon operation and efficiency.

Three laboratory hours per week during the Senior year.

Prerequisites: Theory and Practice of Electrical Measurements; Sophomore Electrical Laboratory.

THESIS.

The subject for thesis investigation will be assigned to the student by the Professor of Fire Protection Engineering *four* weeks before the close of the first semester.

LABORATORY EQUIPMENT.

The plant of the Underwriters' Laboratories, where the laboratory work of this department is conducted, is located at *207 East Ohio Street, Chicago.* Besides ample office and storage room, it now has a general laboratory of about 5,000 sq. ft. for miscellaneous experimental work, electrical laboratories covering about 1,400 sq. ft., a structural materials' laboratory of about 450 sq. ft., a pipe shop 25 by 16 ft., a laboratory 50 by 30 ft. for portable oven tests, and a room 17 by 50 ft.

devoted to tests of dry pipe and alarm valves, and fire hydrants, besides a small chemical laboratory and an open-air enclosure covering about 10,000 sq. ft. for miscellaneous fire tests and other work not practicable within doors.

Hydraulic Equipment.—The following pieces of apparatus are provided: A 500-gallon fire pump, direct-driven by a fifty horse power compound electric motor provided with automatic and manual control; a 12,000-gallon suction tank; a 4,500-gallon pressure tank; a fifty-gallon screw pump, direct-driven by a three horse power electric motor; a three horse power automatic electrically driven air compressor; a New York air brake compressor; three high-pressure hand testing pumps; a specially built Crosby indicator; a Crosby gravity gauge tester; pressure gauges of all necessary ranges; a specially built meter nozzle with interchangeable tips, having a range of from fifty gallons to 2,500 gallons per minute; ten dry pipe valve test stands, with connections to an air system of about 130 feet of six-inch pipe and to an auxiliary 500 gallon air pressure tank; an electrically driven triplex ¾" x 6" pump operating at 5,000 pounds pressure for hydrostatic tests; specially built differential mercury U-gauges of 12 inch, 36 inch, 60 inch, and 84 inch tube lengths.

For tests of automatic sprinklers there are also provided, in addition to the hydraulic equipment listed above, a hot air testing oven, corrosion ovens, apparatus for studying water distribution on smooth, joisted and mill ceilings, a 260-gallon calibrated measuring tank, and a specially built link-testing machine.

Electrical Laboratory.—The equipment comprises a three horse power electric motor driving a three horse power, five-volt heavy current generator and a three horse power, 125-volt alternator; a 40,000-volt transformer; a specially built machine for testing key switches, key sockets, flush switches, etc., driven by an electric motor; a Weston laboratory standard 0-500-volt meter; a Willyoung reflecting D'Arsonval galvanometer with telescope; a Wheatstone bridge; lamp racks, water rheostats and portable ammeters and voltmeters of necessary ranges. Ample power supply is provided for heavy current and short-circuit tests of electrical protective devices.

General.—For general experimental work the laboratories are equipped with a furnace for fire tests of fire-doors, fire-shutters and metallic window frames, five by seven feet in size; a five horse power electric motor driving a centrifugal fan; specially designed ovens for tests of prepared roofings, wired glass and burnt-clay products; a 10,000 lb. Olsen testing machine; a Brown Bros. testing machine with special quadruple-roller attachment for tensile tests of rubber; apparatus for determination of leakage from linen fire hose; a fire hose coupler; a Zeiss microscope magnifying to 1,500 diameters; apparatus for operative tests of hand chemical extinguishers; chemical balances; ap-

paratus for gas analysis; an oil tester for determining flashing temperatures; acetylene and gasolene burner racks; special piezometer fittings for measurement of pressure in flowing streams; fire hose, playpipes, nozzles and reels; scales, thermometers, hydrometers, water gauges, etc.

INSPECTION VISITS.

In the course of the year the following establishments are visited:

Fourteenth Street Pumping Station.
Chicago Avenue Pumping Station.
Fire Boat, Illinois.
Insurance Patrol.
Municipal Fire Alarm Telegraph Department.
Various Special Hazard Risks.
Allis-Chalmers Company.
Joseph F. Sturdy (interior decorator).
Wm. Morris & Sons Company (sash, doors and blinds).
Paris Dyeing and Cleaning Company.
Hafner Furniture Company.
Butler Street Foundry and Iron Company.
Standard Varnish Works.
Keeley Brewing Company.
Florsheim & Co. (shoe manufacturers).

Other special hazard risks; fireproof buildings in course of construction.

VI. THE DEPARTMENT OF ARCHITECTURE.

(THE CHICAGO SCHOOL OF ARCHITECTURE.)

WALTER FRANCIS SHATTUCK, M. A.,
Professor of Architecture.

ANDREW NICHOLAS REBORI, B. S.,
Associate Professor of Architecture.

ROBERT CHARLES OSTERGREN, B. S.,
Assistant Professor of Architecture.

JOHN RINKER KIBBEY, B. S.,
Assistant Professor of Architecture.

CHARLES E. BOUTWOOD,
Instructor in Freehand Drawing.

THOMAS E. TALLMADGE, B. S.,
Lecturer in History of Architecture.

SPECIAL LECTURERS.

LORADO TAFT,
History of Sculpture.

CHARLES FRANCIS BROWNE,
History of Painting.

CRITICS OF ARCHITECTURAL DESIGN.

DANIEL H. BURNHAM.
IRVING K. POND.
DWIGHT H. PERKINS.
HOWARD SHAW.
W. B. MUNDIE.
J. K. CADY.
H. M. GARDEN.
W. K. FELLOWS.
ROBERT C. SPENCER.
H. V. VON HOLST.
LOUIS H. SULLIVAN.

By all competent authorities architecture is regarded as a fine art. It involves, however, so many engineering elements and is so dependent upon them that it must be treated both as an art and a science. The genius of the American people is so mechanical that the danger in this country lies in placing too much emphasis in architectural education upon mathematics and construction and too little upon the artistic elements. In recognition of these facts the course in architecture is made equally a part of the courses in the Armour Institute of Technology and in the Art Institute. By reason of its position, Chicago is one of the most potent influences in the development of American architecture, and to maintain this influence it must support an advanced school of architecture.

As drawing and design are the most essential things in the architect's education, the greatest possible amount of time is devoted to this work. The student's studies are so arranged that the technical studies are given in the morning session at Armour Institute of Technology, so that the afternoon session may be devoted to drawing and purely architectural study at the Art Institute.

Thus the student in architecture has at his disposal the scientific equipment of Armour Institute of Technology and also the extensive and rare collection in the museum of the Art Institute, which embraces not only pictures and sculpture, but also a great variety of objects of art embodying applied design, such as vases, metals, textiles, furniture and antiquities. Relating especially to architecture are the architectural casts formerly belonging to the Columbian Exposition and more important than these, the great collection of casts of French historic architecture unparalleled elsewhere in America. This collection, illustrating the French, Romanesque, Renaissance and modern architecture, came into the possession of the Art Institute through the Columbian Exposition. Students of the course in architecture are admitted to the general literary, musical, dramatic and art entertainments of the two institutions. There are also class lectures upon the history of painting, artistic anatomy and the history of sculpture, besides popular courses upon subjects relating to art.

The course resembles in all particulars the architectural courses of the highest professional schools. All degrees, diplomas and certificates of attainment are given by the Chicago School of Architecture, under the seals of Armour Institute of Technology and the Art Institute. Graduates receive the degree of Bachelor of Science (B. S.) in Architecture.

STATE LICENSE.

The status, equipment, courses of instruction, and the work of the Department of Architecture have been examined by the Board of Examiners of Architects of the State of Illinois, and the graduates from the Department have been accorded the same privileges and exemptions in the State Examinations for Licenses as are accorded to graduates of Columbia University, the University of Pennsylvania, Massachusetts Institute of Technology, Cornell University, Harvard University, and the University of Illinois.

SCHOLARSHIPS AND PRIZES.

(See also pp. 131 and 132)

A medal, the gift of Charles L. Hutchinson, President of the Art Institute, is awarded each year to the student who has the highest general record for his four years' work.

A prize of $250.00 is given annually by the Art Institute to the winner of the Home Traveling Scholarship. This sum must be spent in travel in the United States or in Europe.

Two prizes of $25.00 each are given annually by Mr. Alfred S. Alschuler of the Class of '99 for excellency in design. One of these prizes will be awarded to a member of the Sophomore class and the other to a member of the Junior class.

Prizes of $25.00 each are given for the best designs in terra cotta and ornamental iron.

SUBJECTS OF INSTRUCTION.

I. SHADES AND SHADOWS.

Assistant Professor Ostergren.

The purpose of this course is to present to the student the manner of casting architecture shadows and of working out the shadows of such architectural forms as occur frequently in practice. The student is required to work out plates constructing the shadows by the use of Descriptive Geometry as outlined by a series of lectures.

Two hours per week during the second semester of the Freshman year.

II. PERSPECTIVE.

Assistant Professor Kibbey.

The course is so arranged that the students shall make perspective of all their designs during the second and succeeding years. These perspective drawings are very valuable, in that they show the relations of the masses of the buildings to each other and to the whole as they would appear if the buildings were erected. It is often impossible for the student to appreciate the relation of these masses from the elevation drawings. The student is required to render all perspective drawings in water color.

One hour recitation and three hours drawing per week during the second semester of the Freshman year and one hour recitation and two hours drawing during the first semester of the Sophomore year.

III. FREEHAND DRAWING.

Mr. Boutwood.

The subject of Freehand Drawing is now regarded as one of great importance to the architectural student, although it would seem to bear only indirectly on the subject. In the pursuit of this subject, however, in drawing at first from the cast and later from life, the student's horizon is immensely broadened. He acquires a facility in handling his crayon which reflects itself at once in the

additional dexterity with which he uses his pen and compass in the more exact duties of the course. Furthermore, the eye is trained to a sense of proportion not otherwise obtainable and the general effect of the training is in the direction of a broader culture, very vital for the architect of the present day.

The course is continued throughout the four years, drawing from casts in the collection of the Art Institute and from the figure in the Junior and Senior years.

IV. DESIGN FROM DESCRIPTION.

Assistant Professor Kibbey.

This course is a preparation for the regular course in Architectural Design. Its purpose is to lead the student along the correct manner of studying a subject given to him only by description from which he must make his design.

Two hours per week during the second semester of the Freshman year.

V. ARCHITECTURAL DRAWING AND ELEMENTS OF ARCHITECTURE.

Assistant Professor Kibbey.

The greatest stress is laid on getting the student to a stage where he can draw well, be neat and exact in pencil, pen and wash drawings. No student can advance to the problems in design who can not make a good drawing with good lettering. The Classical Orders are given the student in order to accustom his eye and mind to good architectural proportions. The Orders are drawn and rendered in India ink, teaching the student color values. From the very beginning, even in drawing the Orders the student has to design, making compositions of fragments of the Orders, ample leeway being given him for exerting and exercising his designing ability. Small problems are given, using the Classical Orders as elements of composition.

Twenty hours per week during the first semester and ten hours per week during the second semester of the Freshman year.

VI. HISTORY OF ARCHITECTURE.

Assistant Professor Ostergren and Mr. Tallmadge.

Architectural History is taught by lectures and recitations fully illustrated by means of the stereopticon, books and photographs. The student is required to study the outlines of the general history concurrent with the architectural history, so that he may have an intelligent idea of the relation of the history of a people with their architecture. A thorough knowledge of the great architectural style is

insisted upon, and in order to accomplish this a careful study is made of important examples of each style.

The course is divided into three parts: Ancient, Mediæval and Modern Architecture. The study of the Renaissance is included in the study of Modern Architecture.

Ancient Architecture is studied in the Freshman year, Mediæval in the Sophomore year and Modern in the Junior year; one hour per week during one semester of these years.

VII. GRAPHIC STATICS.

Assistant Professor Ostergren.

This course covers the graphical solution of problems relating to strains in beams, girders and frame structures of all kinds that enter into building construction. The student is required to determine the strain in twenty or more different types of trusses. The design of masonry arches is considered and the effect of wind pressure on walls, towers and chimneys.

Two hours recitation and three hours drawing per week throughout the Sophomore year.

VIII. GENERAL CONSTRUCTION.

Professor Shattuck.

1. *Masonry.*—The following subjects are considered: Location of site; nature of soil; different kinds of foundations and their adaptability to different soils. As Chicago has a great variety of soils, ranging from rock to soft clay or mud, an excellent opportunity is given to study the different kinds of foundations. Under the head of foundations are studied the determination of the dimensions of foundations and footings for a variety of buildings; the manufacture of lime and cements and their uses in mortar and concrete; the manufacture of brick and the many interesting forms of brick construction; varieties of stone, quarrying and dressing of stone, and the use of stone as a constructive material; concrete, its manufacture and adaptability as a constructive material; plasters, including lime, cement and patent or chemical plasters, their formation and application.

2. *Carpentry.*—The subject of carpentry includes the uses of wood in buildings of all classes. The varieties of wood and their adaptability to various forms of construction are first studied; then the rough framing of walls, floors, roofs and partitions and the interior or fine wood work of the building. The student is also required to draw many full-sized details of portions of the buildings which he has designed. Under the subject of carpentry comes the study of hardware, since this is closely associated with the finish of the building.

3. *Inspection Visits.*—Students are required to visit, under the guidance of the instructor, many plants which manufacture building materials, or which make the materials up into the forms used in buildings. Inspection visits are made to brick yards; terra-cotta works, both ornamental and structural; iron foundries, both ornamental and structural; marble works; sheet metal works; woodworking mills and cabinet factories. Inspection visits are also made to buildings of all kinds in process of erection. The variety is so great that all kinds of construction can be studied from the buildings themselves. The inspection visits are also of great value in the study of designing and planning, especially in residence work. The student having access to many fine residences in course of construction can study them in the different stages of construction and as a completed whole. He can obtain a very desirable knowledge of the requirements of the plan, the design in construction of the interior finish and of the many new ideas and treatment of the interior finish and decoration which are constantly being adopted in the finer class of residences.

Three hours per week throughout the Sophomore year of the Courses in Architecture and Fire Protection Engineering.

IX. WATER COLORS AND OUTDOOR SKETCHING. (Sophomore and Junior Years.)

Mr. Boutwood.

As soon as the student begins the study of design he is instructed in rendering his designs in India ink washes and in water color. The instructor in rendering adjusts the time of his instruction to the time of the completion of the design. This system is continued throughout the four years of his course. During the Junior year special attention is given to making water color sketches from color prints and from the ornamental casts in Blackstone Hall; also sketching from nature in the parks.

One hour per week throughout the Sophomore year and two hours during the first semester and four hours during the second semester of the Junior year.

X. SANITARY ENGINEERING.

Professor Shattuck.

This work consists of a series of lectures on the draining of building sites, the drainage and sewerage of buildings, traps and systems of trapping, plumbing fixtures, sewage removal and disposal, improved method of house drainage and sanitary plumbing, the proper arrangements of water closets and bath department, testing of house drains and plumbing work and the sewage disposal for isolated or country residences and buildings.

One hour per week during the second semester of the Sophomore year.

XI. ARCHITECTURAL DESIGN.

Associate Professor Rebori and Assistant Professor Ostergren.

The study of this subject is taken up in the Sophomore year. The problems are simple, stress being laid on the student's acquiring facility of expression of ideas on paper and teaching him to think and reason correctly in the various problems. He is taught the principles of design and their application. Problems are given for designing in different materials, such as stone, wood, iron, terra-cotta, to teach the student that the various materials call for different treament in design.

In the third and fourth years the problems become more extensive. The student is made acquainted with the principles underlying the design of different kinds of buildings and the various requirements for such design. The lectures on Theory of Architecture, History of Ornament, etc., are given in connection with Architectural Design in a way that will enable the student to get a broader understanding for designing and to acquire a method of thinking and reasoning necessary for solving the many complex and diverse problems in the architectural profession.

Sixteen hours per week throughout the Sophomore year and continued throughout the Junior and Senior years.

XII. STRENGTH OF MATERIALS.

Associate Professor Paul.

The laws of stresses and deformation in different materials of construction are discussed and the methods of determining the shearing forces and bending moments in beams are explained. The fundamental formulæ are deduced for the designing of beams, riveted joints, etc.

Two hours per week during the second semester of the Junior year.

XIII. HEATING AND VENTILATION.

Associate Professor Perry.

The general principles of ventilation are considered, together with the required amount of humidity of air, radiating surface, pipe and fittings, various systems of piping, the designing of steam and hot water systems, forced blast systems of heating and ventilation, and regulation of temperature.

Two hours per week during the first semester of the Junior year of the courses in Architecture and Fire Protection Engineering.

XIV. STEEL CONSTRUCTION.

Professor Shattuck.

This course is continued during the Junior and Senior years and consists of a study of the use of steel, wrought iron and cast iron in building construction. The student is required to

design and detail what is known as a steel constructed building. Chicago architects were the originators of this class of building. Since steel constructed buildings are constantly going up, the student has the opportunity to study the details of construction and the methods of erection. As a good working knowledge of the mill book is very valuable in the constructional education of an architect; a careful study is made of the mill books of the large steel manufacturers.

One hour recitation and two hours drawing per week throughout the Junior year.

XV. ARCHITECTURAL ENGINEERING.

Professor Shattuck.

This course is a continuation of the course on Steel Construction. The designing of compound girders and the designing and detailing of the structural steel for the more complicated buildings are studied. The student is required to visit buildings of this type and to make sketches of the details of construction.

One hour recitation and three hours drawing per week throughout the Senior year.

XVI. SPECIFICATIONS AND ESTIMATES.

Professor Shattuck.

A study is made of the clauses of the specifications which relate to all of the trades in general; then of the special clauses relating to each individual trade; also the arrangement and classification of the parts of the specification. A study is made also of forms of contract and business methods.

The methods of estimating by the different systems are discussed and illustrated by problems.

One hour per week throughout the Senior year.

XVII. INTERIOR DECORATION.

Associate Professor Rebori.

Problems are given in the designing of interiors and interior architectural motives, such as fireplaces, stairways, ceilings, wainscoting and the like, all of which is of instant value in the office work which the student takes up on leaving the school.

Two hours per week during the first semester of the Senior year.

XVIII. RESTORATION FROM ANTIQUE ARCHITECTURE.

Associate Professor Rebori.

Blackstone Hall of the Art Institute contains a very fine collection of full size plaster models of many of the most beautiful architectural monuments in Europe. These models formed part of the exhibition

made by the French Government at the Columbian Exhibition. The architectural student has access to these models and during his senior year he is required to make drawings from measurements taken from the models. Such a course, aside from the intimate knowledge of Historical Architecture it gives the student, acquaints him with the substance and appearance of mouldings and decoration in their ultimate size as erected. For a complete understanding of Architecture such exercises go hand in hand with the preparation of drawings on a small scale, which work occupies the major amount of the student's time. The theoretical knowledge gained in the lecture room, for instance, of Gothic Vaulting, is made comprehensible to the student by an examination of the working model of the Cathedral at Rheims in Blackstone Hall. In such manner the theoretical side is made interesting and clear to the student.

Two hours per week during the first semester of the Senior year.

XIX. HISTORY OF SCULPTURE.

Mr. Lorado Taft.

The students of the Senior year are required to attend the lectures on the History of Sculpture in Fullerton Hall and to pass an examination on this subject. The lectures are profusely illustrated and cover the development of sculpture from the Egyptians to the present day.

One hour per week during the first semester of the Senior year.

XX. HISTORY OF PAINTING.

Mr. Charles Francis Browne.

The lectures in this subject cover the development of painting from the few remains we have of the art among the Greeks down to the present day. The course is taken by the Seniors and is a companion course to the History of Sculpture by Mr. Taft.

One hour per week during the second semester of the Senior year.

XXI. ADVANCED ARCHITECTURAL CONSTRUCTION.

Professor Shattuck.

This study is intended for students who wish to specialize in Architectural Construction and consists of the study and execution of working drawings for buildings of different types. Careful detail drawings are made of the many wall, floor, and roof constructions. Foundations are designed for different types of buildings. The student will execute working drawings showing the plumbing, sewerage, heating, and electric wiring.

Sixteen hours per week during the first semester of the Senior year.

XXII. DETAIL DRAWINGS.

Professor Shattuck.

The student is required to execute full size or large scale details of some typical building. This will include structural details, mill details, plaster, marble, and ornamental iron details.

Three hours per week during the first semester of the Senior year.

XXIII. PLANNING.

Professor Shattuck.

Lectures are given on the requirements of planning for commercial buildings, office buildings, warehouses, apartment buildings, and residences.

One hour per week during the first semester of the Senior year.

Inspection visits are made to buildings in process of erection, and sketches are made of details of construction and sanitation.

SPECIAL STUDENTS IN ARCHITECTURE.

Persons applying for admission as special students in Architecture must be college graduates, or *twenty-one* years of age, *with not less than two years of office experience.* Students who are unable to present college credentials are required to pass, before entrance, examinations in Plane and Solid Geometry, and must include in their work at the Institute the regular first-year courses in Freehand Drawing and Descriptive Geometry.

Graduates of colleges are admitted without entrance examinations and will be permitted to enter any of the courses at such a point as their previous range of studies will permit. No student will be allowed to take any subject until he has proved his satisfactory knowledge of all subjects required as preparation for it.

VII. THE DEPARTMENT OF MATHEMATICS.

DONALD FRANCIS CAMPBELL, M. A., Ph. D.,
Professor of Mathematics.
CHARLES WILBER LEIGH, B. S.,
Associate Professor of Mathematics.
ALEXANDER PELL, Ph. D.,
Associate Professor of Mathematics.
CLAUDE IRWIN PALMER, A. B.,
Assistant Professor of Mathematics.

The aim of the instruction in Mathematics is to present the subject so that the student may obtain a thorough working knowledge of those principles which he needs to know when he becomes an engineer. It is recognized that such knowledge can best be obtained by an exercise of the observational faculties of the student, by treating the subject as one coherent whole rather than as a series of more or less disconnected subjects, and by frequent application of the principles taught to problems in engineering. Problems in physics and engineering are especially emphasized and theorems not necessary to an investigation of such problems, no matter how interesting they may be to the student of pure mathematics, are eliminated.

SUBJECTS OF INSTRUCTION.

A. REVIEW ALGEBRA.

Associate Professor Pell and Assistant Professor Palmer.

This course is designed for those students who are not credited with the required number of entrance units in Algebra. It consists of a review of the principles of elementary algebra; a study of the progressions, binomial theorem for positive integral powers of the binomial, the extraction of roots, permutations and combinations.

Prerequisite: Elementary Algebra.

Text-book: Hall and Knight, *Algebra for Schools and Colleges,* revised by F. L. Sevenoak.

Five hours per week during the first semester of the Freshman year of all courses. Repeated during the second semester.

B. SOLID GEOMETRY.

Associate Professor Pell and Assistant Professor Palmer.

This course is designed for those students who are not credited at entrance with Solid Geometry. It consists of a study of the general properties of plane rectilinear figures; lines in space; planes; polyhedra; cylinders; cones; the sphere; similar solids; the construction of regular solids; applications of the principles of solid geometry to a large number of problems.

Prerequisite: Plane Geometry.

Text-books: Sanders, *Plane and Solid Geometry.* Pamphlet of supplementary problems.

Five hours per week during the first semester of the Freshman year of all courses. Repeated during the second semester.

C. PLANE TRIGONOMETRY.

Professor Campbell, Associate Professors Leigh and Pell, and Assistant Professor Palmer.

This course is designed for those students who are not credited with the required number of entrance units in Trigonometry. It consists of a study of trigonometric functions; measurement of angles; trigonometric functions of angles; solution of trigonometric equations; solution of triangles; applications of trigonometry to various problems. The work of this course is supplemented by a review of algebraical principles used in Trigonometry.

Prerequisite: Plane Geometry and Elementary Algebra.

Text-books: Rothrock, *Trigonometry;* Hall and Knight, *Algebra for Schools and Colleges,* revised by F. L. Sevenoak.

Five hours per week during the first semester of the Freshman year of all courses. Repeated during the second semester.

I. COLLEGE ALGEBRA.

Professor Campbell, Associate Professors Leigh and Pell, and Assistant Professor Palmer.

A review of equations; plotting of curves from equations; a comprehensive treatment of surds, imaginaries, ratio, proportion, variation; the progressions; permutations; combinations; determinants; binomial theorem for positive integral powers of the binomial; logarithms; partial fractions; methods of approximation to the roots of equations; addition, subtraction, multiplication and division of complex quantities; building up equations from the properties of curves. A special feature of the course is the introduction of a large number of problems and curves similar to those met with by engineers in actual practice.

Prerequisite: Mathematics A and C.

Course B may be taken along with this course.

Text-books: Hall and Knight, *Algebra for Schools and Colleges,* revised by F. L. Sevenoak; Campbell, *Trigonometric Formulas.*

Five hours per week during the first semester of the Freshman year of all courses. Repeated during the second semester.

II. ANALYTICAL GEOMETRY AND THE ELEMENTS OF CALCULUS.

Professor Campbell, Associate Professors Leigh and Pell, and Assistant Professor Palmer.

Transformation of co-ordinates; a systematic treatment of the circle, parabola, ellipse and hyperbola; limits; the ordinary rules for

differentiation with applications to curve plotting, rates, maxima and minima; the fundamental forms of integration with easy applications to problems in plane areas; those subjects in College Algebra and Analytical Geometry which lend themselves best to Calculus treatment.

Prerequisite: Course I or an equivalent.

Text-books: Riggs, *Analytical Geometry;* Campbell, *The Elements of the Differential and Integral Calculus.*

Five hours per week during the second semester of the Freshman year of all courses. Repeated during the first semester of the Sophomore year.

III. THE DIFFERENTIAL AND INTEGRAL CALCULUS.

Professor Campbell, Associate Professors Leigh and Pell.

A detailed treatment of indefinite integrals; a treatment of definite integrals, with applications to problems in plane areas, lengths of arcs and surfaces of revolution, differentiation of functions of two independent variables; volumes of revolution by means of parallel cross-sections; successive integration with applications to areas, surfaces and volumes; Taylor's theorem; binomial theorem in general; subtangent; subnormal; asymptotes; curvature.

Prerequisite: Course II or an equivalent.

Text-book: Campbell, *The Elements of the Differential and Integral Calculus.*

Five hours per week during the first semester of the Sophomore year of all courses, except the course in Architecture. Repeated during the second semester.

IV. ANALYTICAL MECHANICS.

Professor Campbell, Associate Professors Leigh and Pell.

Statics of a rigid body; statics of flexible cords; motion of a particle under the action of forces in one plane; velocities and accelerations of rotating bodies; work; energy; power, attraction; centers of gravity; moments of inertia; enough of the theory of the strength of materials to enable the student to undertake intelligently the laboratory work in tension, compression and torsion tests. The course also includes a short treatment of Differential Equations.

Prerequisite: Course III or an equivalent.

Text-books: Church, *Mechanics of Engineering;* Campbell, *A Short Course on Differential Equations;* Campbell, *The Elements of the Differential and Integral Calculus.*

Five hours per week during the second semester of the Sophomore year of all courses except the courses in Civil Enginering and Architecture. Repeated during the first semester of the Junior year.

ELECTIVE AND GRADUATE COURSES.

V. DESCRIPTIVE ASTRONOMY.

Associate Professor Leigh.

Description of the most important astronomical instruments; determination of time, latitude and longitude; methods for determination of mass, density, gravitation and orbits of the earth, the moon and the other planets; effects these bodies have on one another, such as tides and magnetic disturbances; application of photography to the study of the stars, etc.

Text-books: Young, *General Astronomy.* Various books and articles announced during the progress of the course.

Two hours per week throughout the year.

VI. DIFFERENTIAL EQUATIONS.

Professor Campbell.

The elementary theory of differential equations.

Text-book: Campbell, *A Short Course on Differential Equations.*

Reference book: Forsyth, *A Treatise in Differential Equations.*

Two hours per week throughout the year.

VII. FOURIER'S SERIES, SPHERICAL HARMONICS AND NEWTONIAN POTENTIAL FUNCTION.

Professor Campbell.

Solutions of Bessel's and Legendre's equations; Fourier's series; problems in flow of electricity and flow of heat; vibrations of stretched strings and membranes; the attraction of gravitation; Greene's theorem; the elements of the mathematical theory of electricity; selected problems.

Text-books: Byerly, *Fourier's Series and Spherical Harmonics;* Peirce, *The Newtonian Potential Function.*

Two hours per week throughout the year.

VIII. VECTOR ANALYSIS.

Associate Professor Pell.

Definition of vectors; addition and subtraction of vectors; application to solution of geometrical problems; equation of straight line and plane; scalar and vector multiplication of vectors; application to geometry and mechanics; differentiation of vectors with applications to geometry of curves and surfaces and to mechanics. Scalar and vector fields; potential; "delta" operator; divergence theorem; curl; Stoke's theorem.

Text-books: Announced at opening of course.

Two hours per week for one semester.

VIII. THE DEPARTMENT OF PHYSICS.

GUY MAURICE WILCOX, A. M.,
Professor of Physics.
THOMAS EATON DOUBT, Ph. D.,
Associate Professor of Physics.
CHARLES FREDERICK HAGENOW, B. S., M. A.,
Instructor in Physics.

Since engineering in all its branches is dependent upon a thorough knowledge of physics, and may be defined as the practical application of physical laws, a clear understanding of physical phenomena and the laws which govern them must precede the more technical studies of the engineering profession. It is the object of the general course to give familiarity with the experimental facts, as well as with the quantities used in physics and with the elementary theory and methods of calculation. For the benefit of those who desire a more general scientific training than can be obtained in the technical engineering courses, and for those who intend to become teachers, or who wish to prepare themselves for original investigation, a number of advanced courses in physics are offered. For carrying on the work of these courses the Institute has a well equipped reference library, supplied with scientific periodicals, and the laboratory is supplied with apparatus for advanced work in heat, light and sound.

SUBJECTS OF INSTRUCTION.

A. ELEMENTARY PHYSICS.

Mr. Hagenow.

The course covers the requirements for admission in this subject. Five lectures and four laboratory hours per week.

Text-books: Millikan and Gale, *Physics;* Crew and Tatnall, *Laboratory Manual of Physics.*

I. GENERAL PHYSICS.

Professor Wilcox, Associate Professor Doubt, Mr. Hagenow.

This course includes the elementary treatment of the mechanics of solids, liquids and gases; heat, sound, light and electricity. Particular attention is given to the fundamental ideas and principles upon which the science of engineering is based, and much stress is laid upon the solution of problems of a practical nature.

Text-book: Duff, *A Text-book of Physics.*

Five hours per week during the Sophomore year of all courses.

Prerequisite: Freshman Mathematics.

II. LABORATORY PHYSICS.

Associate Professor Doubt, Mr. Hagenow.

The laboratory experiments are intended to give practice in the use of standard apparatus and training in the methods of making and recording physical measurements. Accurate measurements of length, mass and density by means of the comparator, cathetometer, dividing engine and balance; the determination of the constants of gravity, elasticity and surface tension; calorimetric measurements; the use of the spectroscope, spectrometer, polariscope and grating; determination of the velocity and pitch of sound are among the more important exercises.

Text-book: Special laboratory directions.

Three hours per week during the Junior year of the Mechanical, Chemical and Fire Protection Engineering courses, and during the Sophomore year of the Electrical Engineering course.

ELECTIVE COURSES.

III. LIGHT.

Associate Professor Doubt.

This course is designed to give a more extended knowledge of the phenomena of refraction, dispersion, diffraction, interference and polarization of light than can be obtained from Courses I and II.

Text-book: Preston, *Theory of Light; References.*

Three lectures a week during the first semester. Six hours per week in the laboratory may be taken with this course.

IV. HEAT.

Professor Wilcox.

An advanced course of lectures, with laboratory practice in the use of the gas thermometer, platinum resistance thermometers for high and low temperatures, accurate determination of expansion co-efficients, various methods of measuring specific heats, determination of heat of combustion and experiments in radiant heat.

Text-book: Preston, *Theory of Heat.*

Three lectures and six laboratory hours per week during the second semester. The lectures may be taken without the laboratory work.

V. RADIATION.

Associate Professor Doubt.

An experimental study of the laws of radiation and their application to pyrometry, spectrum analysis, spectrophotometry, transformation of radiant energy into chemical energy, and their relation to selective radiation and absorption.

Two lectures per week during the first semester.

Three hours in the laboratory may be taken with the lectures.

VI. ELECTRIC WAVES.

Professor Wilcox.

A study of the principles involved in the production and transmission of electric waves. The course includes experiment as well as theory, with particular attention to the application of electric waves in wireless telegraphy and wireless telephony.

Open to Juniors and Seniors.

Two hours per week during the first semester.

EQUIPMENT.

The Physics Lecture Room is on the second floor of the Main Building and is equipped with projection apparatus for optical experiments as well as for lantern slides and ordinary projections. The lecture table has connections for water, gas, and electricity. An extensive collection of demonstration apparatus is used to illustrate the lectures on mechanics, heat, sound, light, electricity, and magnetism.

The Physics Laboratory occupies the first floor and half of the second floor in Chapin Hall. Slate capped piers and heavy slate wall shelves give stability for sensitive apparatus. Current from a storage battery in the basement is distributed to convenient terminals by means of a switchboard. The Laboratory is supplied with compressed air by a small motor driven air compressor. A Riefler clock serves as a time standard. Some of the more important pieces of apparatus are the following: Linear and circular dividing engines, a comparator, two cathetometers, Kater pendulum, three spectrometers, Bunsen spectroscope. (All made by the Societe Genevoise.) Six high grade balances, a supply of thermometers of various types, including standards calibrated by the Bureau of Standards and at Kew, a Rowland concave grating of about two meters focus, a Hilger wave length spectroscope, two Michelson interferometers, a platinum resistance furnace, Brace spectrophotometer, Schmidt and Haensch polariscope, Lummer-Brodhun photometer, optical bench equipped for the study of interference and diffraction of light.

The services of a skilled mechanician are available for repairs and for the construction of special apparatus as required.

IX. THE DEPARTMENT OF ENGLISH.

WALTER KAY SMART, Ph. D.,
Professor of English.

CLYDE BARNES COOPER, A. M.,
Associate Professor of English.

WILLIAM WAY MANNING,
Instructor in English.

JULIA BEVERIDGE, Librarian,
Instructor in Bibliography.

The work of the Department of English comprises courses in composition and literature. The courses in composition are made as practical as possible, for it is recognized that the engineering student is primarily interested in the study of composition, not as a literary training, but as a drill in expressing his thought freely, clearly and forcibly. The writing of straightforward English, therefore, is the end toward which the efforts of the student are directed. The Freshman course covers the fundamental principles of composition and the practical application of them to the student's own writing. In the Sophomore year the work is more detailed and attempts by analysis of good selections to enable the student to appreciate more of the details of structure and style. But this, like all other composition work in the Department, is made subordinate to actual practice.

In the courses in Literature the object is to cultivate in the student an appreciation of the best literature and to acquaint him with as wide a range of reading as is possible in the allotted time. Consequently, the work consists of the rapid reading of many works instead of the detailed study of a few. A printed list of books to be read is furnished to each student at the beginning of the Freshman year.

English is required throughout the Freshman and Sophomore years of all courses, and the work is continued so far as practicable throughout the following two years. *The Professor of English has the authority to cause any student deficient in English to report to him for special work in that subject.* All graduating theses are submitted to the Department of English for criticism before they are presented to the Committee on Degrees for final judgment.

SUBJECTS OF INSTRUCTION.

I. RHETORIC AND COMPOSITION.

Professor Smart, Associate Professor Cooper, Mr. Manning.

English Composition is taught by means of lectures, class room exercises, written work, and consultation. The principles of composi-

tion are treated with reference to the whole composition, the paragraph, the sentence, and the word. Besides the weekly theme, a large amount of extemporaneous writing is required in class. *Each student has a weekly private conference with his instructor in which to discuss the revision of the theme.*

Text-book: Canby, *English Composition.*

Two hours per week during the first semester of the Freshman year of all courses.

II. FORMS OF ENGLISH LITERATURE.

Professor Smart, Associate Professor Cooper.

The origin, the development, and the characteristics of the following literary types are discussed: The Epic, the Ballad, the Lyric, the Novel, the Short Story, the Essay. The work consists of lectures and assigned readings.

Two hours per week during the second semester of the Freshman year of all courses.

III. SHAKESPEARE.

Professor Smart, Associate Professor Cooper.

After introductory lectures on the classical, mediaeval, and pre-Shakespearean drama, a number of Shakespeare's plays are read, with special reference to his development as a dramatist. Papers on plays not read in class are also written by each student.

One hour per week during the first semester of the Sophomore year of all courses except the course in Architecture.

IV. RHETORIC AND COMPOSITION (Advanced Course).

Professor Smart, Associate Professor Cooper.

This course consists of lectures on structure and style, and analysis of typical selections illustrating the points discussed in the lectures. One theme per week is required.

One hour per week during the second semester of the Sophomore year of all courses except the course in Architecture.

V. SPECIAL COMPOSITION.

Professor Smart, Associate Professor Cooper, Mr. Manning.

A course in Composition, supplementary to Course IV, is required of any upper classman whose written work shows that he is unable to express his ideas clearly and accurately. ***This course consists entirely of theme writing and consultation and may be continued in each case as long as deemed necessary.***

ELECTIVE COURSES.

Open to the Sophomores, Juniors, and Seniors of all courses.

VI. THE AGE OF CLASSICISM.

Professor Smart.

A rapid reading of the works of Dryden, Swift, Pope, Addison, and Steele, and a study of the characteristics of the period in general.

Two hours per week during the first semester.

VII. THE ROMANTIC MOVEMENT.

Professor Smart.

A course in the literature of the romantic revival in the early nineteenth century. Lectures and readings.

Two hours per week during the second semester.

VIII. ARGUMENTATION AND DEBATING.

Associate Professor Cooper.

A study of the principles of argumentation with practice in the preparation and delivery of forensics.

Text-book: Foster, *Argumentation and Debating.*

Two hours per week during the first semester.

IX. PUBLIC SPEAKING.

Associate Professor Cooper.

Practice in the preparation and delivery of speeches.

Text-book: Baker, *Forms of Public Address.*

Two hours per week during the second semester.

X. BIBLIOGRAPHY.

Mrs. Beveridge.

Instruction in the use of books. Students are made familiar with the various reference and bibliographical works and are required to make out special bibliographies upon assigned subjects. A systematic study of bibliographical indexes, dictionaries, and encyclopaedias, and of the principles of classification and cataloguing. The Dewey System of Classification is used. Inspection visits are made to the Crerar Library, the Newberry Library, and the bindery. Lectures.

The course is repeated each semester.

One hour per week.

X. THE DEPARTMENT OF HISTORY AND POLITICAL SCIENCE.

GEORGE LAWRENCE SCHERGER, Ph. D.,
Professor of History and Political Science.
CHARLES H. ALLING, JR., LL. B.,
Lecturer in Business Law.

The courses offered in this department aim to give the student a knowledge of the development of culture in its most important phases, from primitive times down to the present; to acquaint him, more particularly, with the political, economic, social, and intellectual development of modern times; to stimulate his interest in the problems of the present; to familiarize him with the political institutions of the leading European nations as well as of America; and to train him for the duties of citizenship.

Courses I, II and III follow each other in consecutive order. They are prescribed for the Freshman and Sophomore years of all courses.

SUBJECTS OF INSTRUCTION.

I. HISTORY OF CIVILIZATION.

Professor Scherger.

A general survey of the origin, progress, and character of European civilization. The topics treated are: Greek views of life; the Greek drama; the social life of the Greeks and Romans; Rome's bequest to civilization; Christianity; Teutonic life and institutions; feudalism; the artistic and intellectual life of the Middle Ages; the Renaissance; the Reformation and its view of life; the origins of modern thought; idealism; the theory of evolution.

Lectures and readings.

One hour per week throughout the Freshman year of all courses.

II. POLITICAL SCIENCE.

Professor Scherger.

The work comprises a study of the origin and development of American political institutions. Careful attention is given to the consideration of the problems of municipal government. Comparisons are made between our institutions and those of the leading European states. Important questions of the day are given due consideration.

Lectures and readings.

One hour per week during the first semester of the Sophomore year of all courses.

III. HISTORY OF RECENT TIMES.

Professor Scherger.

The work comprises a study of the political, intellectual, economic, and social progress of Europe since 1789. Emphasis is laid upon the study of the French Revolution, the development of liberty and constitutional government, the work of the leading statesmen, the chief schools of thought and the progress of invention and industry.

Lectures and readings.

One hour per week during the second semester of the Sophomore year of all courses.

IV. BUSINESS LAW.

Mr. Alling.

This work is intended to cover the laws governing ordinary business transactions. Only well-established elementary principles are discussed and illustrations of their application are given. The following outline indicates the scope of the work:

Contracts.—Essential elements; necessity for consideration; what constitutes consideration; classes of contracts required to be in writing; contracts by infants; effect of fraud and illegality; time within which suit must commence.

Sales.—Essential elements; when title passes; conditions and warranties; rights of unpaid seller.

Negotiable Instruments.—Notes, drafts and checks, the contracts of maker, drawer and indorser; necessity for presentment and notice of non-payment; judgment notes; time allowed by law to present checks.

Real Estate.—Warranty and quit-claim deeds; mortgages and trust deeds, tax sales and tax deeds; dower rights; landlord and tenant; leases; liens on real estate.

Partnership.—Liability of partners for partnership debts; partnership contracts; limited partnership.

Corporations.—Methods of incorporating companies; corporate contracts; liability of stockholders; transfers of stock; powers of stockholders and powers of directors.

Text-book: Special notes.

Two hours per week during the first semester of the Senior year of all courses.

ELECTIVE COURSES.

Open to the students of all courses.

V. MUNICIPAL GOVERNMENT AND ADMINISTRATION.

Professor Scherger.

Among the topics considered are: The cities of the Middle Ages; the origin of modern city government; causes of the growth of modern

cities; the government and administration of the leading American and European cities; problems of city government; municipal ownership.

Lectures and readings.

One hour per week during the first semester.

VI. HISTORY OF THE FRENCH REVOLUTION AND THE NAPOLEONIC ERA.

Professor Scherger.

A careful study of the political, social, intellectual, and economic conditions in France on the eve of the Revolution. The leading events and persons of the Revolution are then studied. Finally the influence of the Revolution in Europe is carefully considered.

Lectures and readings.

One hour per week during the second semester.

VII. THE THEORY OF THE STATE.

Professor Scherger.

A study of certain general questions of political science, such as the origin and ends of the State, the development of the forms of the State, the branches of government, genesis of written constitutions, the evolution of liberty and democracy.

Hours to be arranged.

VIII. IMPORTANT QUESTIONS OF THE DAY.

Professor Scherger.

Discussions and debates upon current topics such as popular election of U. S. senators, the initiative and referendum, socialism, ship subsidies, the suffrage, with a view to thorough preparation for citizenship.

Hours to be arranged.

XI. THE DEPARTMENT OF MODERN LANGUAGES.

AUGUST RAYMOND ZORN, A. B.,
Assistant Professor of Modern Languages.

The aim of the instruction in the modern languages is chiefly to reach the greatest practical results, which are thought to be attained when the language studied has become an "effective aid to the continued acquisition of knowledge." Stress is laid on a thorough and systematic study of the structure of each language. In translating new passages ("at sight"), great attention is given to the force of voice, mode, tense, number, person of verbs and of case and gender in nouns and adjectives. A good working knowledge of grammar is demanded of every student applying for credits in modern languages. (See Entrance Requirements.)

SUBJECTS OF INSTRUCTION.

I. ELEMENTARY FRENCH.

Assistant Professor Zorn.

The work comprises a thorough study of elementary French, with drill in pronunciation and in grammar. As far as possible French is spoken in class.

Text-books: Fraser and Squair, *French Grammar;* François, *Simple French;* Verne, *Forceurs des Blocus;* Dumas, *La Tulipe Noire;* Erckman-Chatrian, *Waterloo,* or Halévy, *L'Abbé Constantin.*

Five hours per week throughout the year.

II. INTERMEDIATE FRENCH.

Assistant Professor Zorn.

The aim of this course is to review the grammatical work done in Course I and to qualify the student to acquire the technical vocabulary of science.

Text-books: Davies, *Scientific French Reader;* Bowen, *Scientific French Reader;* Luquien, *Popular Science.*

Three hours per week throughout the year.

Prerequisite: French I, or an equivalent.

III. ELEMENTARY GERMAN.

Assistant Professor Zorn.

Study of accidence; the elements of syntax; dictations; prose composition; sight translation; use of German in class room.

Text-books: Vos, *Essentials of German;* Huss, *German Reader;* Storm, *Immensee;* Schiller, *Das Lied von der Glocke;* some light comedy by Elz or Bendix for sight reading.

Five hours per week throughout the year.

IV. INTERMEDIATE GERMAN.

Assistant Professor Zorn.

Review of grammar; syntax. The aim of the instruction is to make the students acquainted with the technical vocabulary of science.

Text-books: Joynes-Meissner, *German Grammar;* Gore, *Scientific German Reader;* Hodges, *Scientific German Reader;* Moser and Heiden, *Köpnickerstrasse 120;* translations of scientific articles in German publications.

Three hours per week throughout the year.

Prerequisite: German I, or an equivalent.

ELECTIVE COURSES.

V. ADVANCED GERMAN.

Assistant Professor Zorn.

Composition, conversation, selected readings. Lectures and readings on the classic epoch of German literature.

In 1912-1913 the following masterpieces will be read: Lessing, *Nathan der Weise;* Goethe, *Hermann and Dorothea;* Schiller, *Wallenstein.*

Three hours per week throughout the year.

Prerequisite: German I and II, or an equivalent.

VI. ADVANCED FRENCH.

Assistant Professor Zorn.

Composition, conversation, selected readings. Lectures and readings on the classic epoch of French literature.

In 1912-1913 the following will be read: Molière, *L'Avare;* selections from Corneille, Racine, Boileau, Victor Hugo.

Three hours per week throughout the year.

Prerequisite: French I and II, or an equivalent.

VII. ELEMENTARY SPANISH.

Assistant Professor Zorn.

A course in elementary Spanish. The aim is to reach the greatest practical results. Stress is laid upon pronunciation and conversation.

Text-books: Garner, *Spanish Grammar;* Carter and Malloy, *Cuentos Castellanos.*

Three hours per week throughout the year.

VIII. INTERMEDIATE SPANISH.

Assistant Professor Zorn.

Composition, conversation, selected readings.

Texts for 1912-1913: Smith, *Gramática Práctica;* Alarcón, *El Capitan Veneno;* Galdo's *Marianela.*

XII. THE DEPARTMENT OF ECONOMICS AND PHILOSOPHY.

LOUIS C. MONIN, Ph. D.,
Professor of Economics and Philosophy.

The course in Economics is planned to give a comprehensive knowledge of the essentials of Economic Science to technical students (Junior year) whose chief interest lies in other departments of study.

The courses in Logic and Psychology are intended to acquaint the student with the more important mental processes, assumptions and laws that underlie all human knowledge. In order "to see life steadily and see it whole" the literary type of collegiate education on the one hand needs at least a certain amount of scientific knowledge and accuracy, and the scientific type, on the other hand, must be infused with the broadening and inspiring spirit of literary and philosophic thought. It is with this end in view that these courses are offered to the Seniors.

SUBJECTS OF INSTRUCTION.

I. PRINCIPLES OF ECONOMICS.

Professor Monin.

A comprehensive study of the principles of economics. Special attention is devoted to the mode in which economic principles are illustrated by American experience.

Text-book: Ely, *Outlines of Economics (Revised Edition).*

Lectures, outside reading and occasional written work.

Two hours per week throughout the Junior year of all courses.

II. LOGIC.

Professor Monin.

A study of the nature of logic, inductive and deductive, and of its significance for science.

Lectures, recitations and exercises.

Two hours per week during the first semester of the Senior year of all courses.

III. PSYCHOLOGY.

Professor Monin.

A brief outline of the structure of the nervous system and a study of the more important mental processes.

Lectures and outside reading.

Two hours per week during the second semester of the Senior year of all courses.

ELECTIVE COURSES.

Special work and hours will be arranged to meet the demand of students interested in economic and philosophic studies.

IV. INTRODUCTION TO PHILOSOPHY.

Professor Monin.

A study of the different divisions of philosophy and of the fundamental problems of each. Lectures and readings.

Two hours per week during the first semester.

V. ETHICS.

Professor Monin.

A short and comprehensive survey of the science of conduct and a study of fundamental ethical concepts. Lectures and readings.

Two hours per week during the second semester.

VI. HISTORY OF EDUCATION.

Professor Monin.

A survey of educational theories and practices from antiquity to the present time. Lectures and readings.

Two hours per week throughout the year.

Students preparing to enter the profession of teaching are particularly advised to enroll in some of the electives offered.

XIII. THE DEPARTMENT OF PHYSICAL CULTURE.

HENRY BASCOM THOMAS, B. S., M. D.,
Professor of Hygiene, Medical Adviser, and Director of Physical Culture.

HARRY E. HURLBUT,
Assistant in the Gymnasium.

The work of the Department of Physical Culture comprises:

I. Medical Examination and Advice.
II. Gymnasium Class Work and Games.
III. Supervision of Athletics (in co-operation with the Board of Athletic Control).

Upon entering the Institute all students undergo a medical examination and a strength test. The facts thus obtained are tabulated, charts are made and assignments to class work and games are based on the results of these examinations. Other medical services include first aid to students who are injured in the shops or on the field.

All first year students are required to attend a gymnasium class two hours per week for two semesters, for which work due credit is given. Constant attention is paid to the student's physical condition and development and suitable exercises are prescribed to meet the particular needs of the individual.

The gymnasium is thoroughly equipped with apparatus, shower baths and dressing rooms.

An honorable place is accorded *Athletics,* which is under the supervision of the Board of Athletic Control (page 125). All candidates for the various athletic teams are required to submit to a physical examination before they are allowed to take up a course of training. *No student is allowed to become a member of an athletic team who is deficient in his studies.*

The gift of $250,000 made to the Institute in 1904 by Mr. J. Ogden Armour has made possible the acquisition of the residence block north of Thirty-third Street and west of Dearborn Street for a permanent athletic field.

PERSONAL HYGIENE.

Dr. Thomas.

Lectures on *personal hygiene* and on *resuscitation of persons injured by electricity* are given to all college students.

XIV. GRADUATE COURSES.

LEADING TO THE DEGREE OF MASTER OF SCIENCE.

Special work will be arranged to meet the requirements of each individual student.

MECHANICAL ENGINEERING.

Research work in Applied Mechanics, Steam Engineering, Hydraulics, Machine Design, Power Plant Engineering.

ELECTRICAL ENGINEERING.

Research work in lines related to the Design or Operation of Electrical Machinery, in the measurement of Electric or Magnetic Quantities, and in the various phases of Telephone Engineering.

CIVIL ENGINEERING.

Research work in Hydraulic Engineering, including Power Plant Design; Sanitary Engineering; Structural Engineering; Railroad Engineering and Geodesy.

CHEMICAL ENGINEERING.

Research work in Inorganic Chemistry, Industrial Chemistry, Quantitative Analysis, and Sanitary Chemistry.

MATHEMATICS, PHYSICS.

The graduate courses and electives offered in mathematics are described on page 106; in physics, on page 108.

Electives in other subjects are described in the respective departments.

EVENING CLASS INSTRUCTION.

(A special bulletin describing the different courses offered will be sent upon application.)

In response to the demand for instruction on the part of boys and men who are employed during the day and cannot avail themselves of the opportunities afforded by day classes, Armour Institute of Technology offers instruction in Evening Classes. The courses are selected with special reference to the needs of those who are engaged in technical pursuits. Full credit is given for any of the studies satisfactorily completed in the College Preparatory Course of the Evening Classes. Correspondence school students find the opportunities for laboratory, shop and drafting room work especially helpful. Machinery Hall is equipped with the most modern appliances for shop instruction, and provides unusual facilities for engineering students. The instruction is under the supervision of the Dean of the Engineering Studies.

EXPENSES.

Each subject is given from 7:30 to 9.30 p. m., twice a week, either on Monday and Thursday, or Tuesday and Friday, unless otherwise stated.

Tuition varies from $10.00 to $15.00 per term of ten weeks, according to course.

A *deposit* of $4.00 is required of students in chemistry, and of $2.00 for the shop courses, to insure against breakage and loss of material. At the end of the term, after deducting for breakage, the balance is refunded.

A *fee* of $3.00 per term is also required of all students in chemistry and shop work.

Those who intend to enter should make early application. The Institute reserves the right to withdraw any course for which there is not a sufficient number of applications.

CALENDAR.

Autumn Term. The autumn term begins Monday evening, October 7, 1912, and continues for ten weeks.

Winter Term. The winter term begins Monday evening, January 6, 1913, and continues for ten weeks.

Spring Term. The spring term begins Monday evening, March 17, 1913, and continues for ten weeks.

Members of the faculty are at the Institute on registration evenings to meet students and advise them in the selection of their courses.

SUMMER SESSION.

Monday, June 24th, to Friday, August 2nd, 1912.

(A special bulletin describing the different courses offered will be sent upon application.)

The summer courses offered by Armour Institute of Technology are designed to meet the needs of teachers and special students who desire to extend their knowledge of scientific and technical subjects; of undergraduates desirous of shortening their regular courses; of new students deficient in certain studies required for admission; and of those who are unable to attend during the school year.

Students may enter the Institute in the summer session, instead of waiting until the autumn term. This is particularly advisable for those students who are conditioned in any of the studies required for admission. It allows them to make up their deficiencies, and gives them an opportunity to become familiar with the methods of instruction.

Special courses in shop work and laboratory practice are offered for mechanics and apprentices. Machinery Hall is equipped with the most modern appliances for shop instruction, and provides unusual facilities for engineering students.

Students preparing for college by correspondence can review their preparatory studies before entering upon their regular college course, and will find the laboratory and shop courses especially helpful.

Teachers of manual training, or those who wish to become candidates for certificates in the public schools, will find the shop and drawing courses well adapted to their needs, as they cover the requirements of the Board of Education of the City of Chicago.

Tuition varies from $10.00 to $30.00 according to course.

A deposit of $5.00 is required of students in chemistry. After a deduction for breakage the balance is refunded at the end of the session.

A fee of $3.00 is required of students in chemistry and shop courses.

Tuition is payable in advance and no rebate is allowed on tuition paid.

Those who intend to enter should make early application.

For further information address the Dean of the Engineering Studies, Armour Institute of Technology, Chicago.

GENERAL INFORMATION.

ADVISERS.

The Deans are the general consulting officers for students, and co-operate with the President in all matters touching discipline, studies, and other student relations.

MEDICAL ADVISER.

Dr. Henry Bascom Thomas, 31 North State Street, is the Medical Adviser for students, and Director of Physical Culture. He will address the students during the year on personal hygiene and on resuscitation of persons injured by electricity.

ASSEMBLIES.

From time to time, eminent men in public or professional life are invited to address the students of the Armour Institute of Technology. It is believed that every institution of learning should furnish to its students the opportunity of meeting personally men and women of force of character and of high ideals in life.

Attendance at assemblies is compulsory for all students.

Among those who have visited the Institute are:—

Hon. William Howard Taft, President of the United States;
Charles W. Eliot, LL. D., Ex-President of Harvard University;
The Late United States Senator George F. Hoar;
General Adna R. Chaffee, Ex-Commander in Chief of the United States Army;
The Late United States Senator Marcus A. Hanna;
The Late Grover Cleveland, Ex-President of the United States;
The Late Rev. Edward Everett Hale, Washington, D. C.
United States Senator Elihu Root;
Hon. Leslie M. Shaw, Ex-Secretary of the Treasury;
The Late United States Senator Jonathan P. Dolliver;
Dr. Adolph Lorenz, Vienna, Austria;
John Findlay Wallace, Ex-Chief Engineer of the Panama Canal;
General William Sooy Smith;
Rev. W. J. Dawson, D. D., London, England;
Arthur T. Hadley, LL. D., President of Yale University;
Rev. Lyman Abbott, D. D., New York;
Hon. William Jennings Bryan, Lincoln, Nebraska.
Dr. Henry S. Pritchett, New York.

ATHLETICS.

The management of athletics is vested in the *Board of Athletic Control,* consisting of the following members:

The Comptroller,
The Dean of the Cultural Studies,
The Dean of the Engineering Studies,
The Director of Physical Culture,
Two Members of the Faculty,
Three College Students.

All candidates for the various athletic teams are required to submit to a physical examination before they are allowed to take up a course of training. *No student who is deficient in his studies is allowed to become a member of an athletic team.*

The gift of $250,000 made to the Institute in 1904 by Mr. J. Ogden Armour has made possible the acquisition of the residence block north of Thirty-third Street and west of Dearborn Street for a permanent athletic field.

See also Department of Physical Culture, page 120.

ATTENDANCE.

A careful record of attendance upon all exercises at the Institute is kept for each student. In case of absence from exercises, an amount is deducted from the class work of the student equal to the percentage of time lost. In case a reasonable excuse for the absence is offered, the student may be permitted to make up the time lost and be given credit for the work. Laboratory, drawing, and shop time lost can be made up only if arrangement is made for the work during regularly scheduled working hours in the respective departments.

A student incurring five unexcused absences during the college year severs his connection with the Institute.

BOARD AND ROOMS.

The Institute provides no dormitory system for its students. Board and rooms may be obtained in the vicinity of the Institute at prices ranging from $6.00 to $8.00 per week. Information is furnished at the office of the Registrar.

Meals are served daily from 11 a. m. until 2 p. m. at a very moderate cost in the Dining Hall at the north end of Ogden Field.

The Armour Y. M. C. A. publishes annually a small handbook containing useful information for students. Addresses of private families renting rooms to students may also be obtained from the Secretary of Armour Y. M. C. A.

BUILDINGS.

The work of the Institute is carried on in the buildings at the corner of Armour Avenue and Thirty-third Street. The artistic and technical branches of the course in Architecture are conducted at the Art Institute, Michigan Avenue and Adams Street. The technical laboratory work of the course in Fire Protection Engineering is given at the Underwriters' Laboratories, *207 East Ohio Street, Chicago.*

Main Building.—This building was erected in 1892. It is fire-proof throughout, built of stone and pressed brick, and five stories in height. It contains the offices of the President, of the Comptroller, and of the Deans, the library, the dynamo and hydraulic laboratories, the laboratories of electrical engineering, of physics and chemistry, drafting rooms, lecture and recitation rooms. In all the rooms and corridors may be found the best specimens of the engraver's and etcher's art, and from time to time valuable paintings are placed on exhibition for the enjoyment and education of the students.

Machinery Hall was completed in September, 1902. It is four stories in height, built also of stone and pressed brick to conform with the architecture of the main building, of saw-tooth roof construction, and fire-proof throughout. Each floor has a shop of 3,600 square feet of clear floor space, besides lecture rooms, tool, wash, and locker rooms. The first floor is devoted to the forge shop, the second to the machine shop, the third to the pattern shop, the fourth to the foundry, the basement to storerooms and to the heating and ventilating apparatus.

The forge shop is on the first floor in order that the massive foundations of the steam power hammers may be built up from the ground and be independent of the rest of the building, and also that the exhauster, blower, and piping for the down-draft forges may be in the basement. The foundry is placed on the top floor to reduce the height of the cupola stack, and to secure the advantage of the superb lighting from the saw-tooth roof for floor moulding. Each shop is equipped with a lecture room. The forge shop lecture room is equipped with an anvil and a down-draft forge; the machine shop lecture room with an engine lathe and a bench tool grinder; the pattern shop lecture room with a 5-foot pattern maker's lathe and a pattern maker's bench; the foundry with a bench, and the usual flasks and equipment. The general plan is to precede the execution of an exercise in the shop by a lecture from the instructor, who gives the necessary information as to materials and methods, and, as far as desirable, describes a part or all of the work to be done. The repeated individual instruction under older methods is thus avoided. Each floor has its lavatories and locker rooms. The lockers are of the expanded metal type, 15″x15″x42″ each, and erected in double tiers, 124 lockers to each floor. The shops are heated by forced draft which is automatically regulated by thermostats,

while the lavatories are heated by steam. The air intake chamber is so constructed and isolated that an air cooler may be installed should such a course prove desirable at any time. The general lighting throughout the shop is by enclosed arc lamps, augmented by incandescent drop lights at each machine. A 4-ton electric freight elevator runs from the basement to the charging floor of the foundry, and is accessible to all the shops at both the main landings and tool rooms. All windows are of ribbed wire glass construction. An automatic electrically driven house pump furnishes the shops with water, while an air compressor in the foundry furnishes them with compressed air. Each shop has its own motor for driving the line shafting and each demonstration room is equipped with a ceiling motor.

This building contains also the offices of the department of mechanical engineering.

Assembly Hall (Armour Mission).—In this building are located the office of the Registrar, the department of Civil Engineering, the drafting room of the Seniors of the electrical and mechanical engineering courses, and the freehand drawing room. Assembly Hall has a seating capacity of 1,000 and is provided with an organ and a platform.

Chapin Hall was opened in 1907. In it are located the physical laboratories, the mechanical engineering drafting rooms, Chapin Club, the offices of the Board of Athletic Control, the meeting rooms of the different engineering societies, the offices of the department of mathematics and of the college publications, and the rooms of the Tau Beta Pi fraternity.

Dining Hall.—This building, built of red brick, is located at the north end of Ogden Field, occupying a frontage of 26 feet with a depth of 100 feet. The entire lower floor is used as a dining hall for the students and for social gatherings in connection with the Institute. In this hall, meals are served daily from 11 a. m. until 2 p. m., at a very moderate cost.

The upper floor comprises a 7-room flat occupied by the care taker of the building; also a locker room with 100 lockers for use of the members of the several athletic teams, and shower baths.

The Institute may be reached by the South Side Elevated Railroad, the State Street or the Wentworth Avenue Electric Lines to Thirty-third Street.

CHAPIN CLUB.

Chapin Club was organized in 1907 and is located in Chapin Hall. A generous donation made for this purpose by Mr. Simeon B. Chapin, Trustee of the Armour Institute of Technology, made possible the organization of this club, the object of which is to promote the social interests and welfare of the student body.

COLLEGIATE YEAR.

The collegiate year consists of thirty-six weeks, divided into two semesters of eighteen weeks, respectively.

DEGREES.

The degree of *Bachelor of Science,* in the course pursued, is given for the completion of one of the following regular courses of study:

Mechanical Engineering.
Electrical Engineering.
Civil Engineering.
Chemical Engineering.
Fire Protection Engineering.
Architecture.

To be entitled to a degree the applicant must have been in residence at the Institute for at least one year next preceding his graduation, must have completed the prescribed studies of the four years, and prepared a thesis on some subject included in his course of study.

No degree can be conferred until all dues to the Institute are discharged.

The degree of *Master of Science* is awarded to students who have satisfactorily pursued a complete graduate course of resident study of one year and have submitted a thesis. In case the candidate for the degree of Master of Science does not hold the degree of Bachelor of Science from the Armour Institute of Technology, he must have taken his first degree in some university or college of good standing.

The degree of *Mechanical Engineer, Electrical Engineer, Civil Engineer, Chemical Engineer,* or *Fire Protection Engineer,* may be obtained by submitting a thesis after at least three years of successful engineering practice or teaching, of which two shall involve responsibility.

In no case, however, are these degrees to be granted to a person not a graduate of the Armour Institute of Technology, unless he has been in residence at the Institute for at least one year.

DISCIPLINE.

Upon entering the Armour Institute of Technology every student signs the following declaration:—

"In making this application I covenant to obey all the laws of the land, and especially the ordinances of the city, and those unwritten rules of courtesy and manliness, the obedience of which will prevent my going into any place which will reflect discredit upon the Institute. I understand that the Institute reserves the right and considers it a duty, at any time, to remove any student whose presence is detrimental to the progress of the institution."

Otherwise only such regulations are required to be observed as are necessary to the maintenance of good order. Self-knowledge and self-control are inculcated as fundamental principles in education, but no unnecessary restrictions are imposed.

EXAMINATIONS AND REPORTS.

Examinations are held in all subjects at the close of each semester. Students are graded both upon semester work and upon examinations.

The grading is as follows: A, 95—100%
B, 85— 95%
C, 75— 85%
D, 60— 75%, Conditioned.
E, below 60%, Failed.
Passing grade: 75%.

While the standing of students in regard to scholarship is determined by means of examinations, regularity of attendance and faithful performance of daily work are considered equally essential.

Conditions.—Students conditioned in any subject must remove such condition at the regular examination given for that purpose during the following semester.

Failing to remove the condition, the student is required to discontinue the subject and to repeat it when it is given again.

Each student taking a special examination is charged a fee of $2.00.

A student failing in the majority of his studies severs his connection with the Institute.

Reports.—At the close of each semester reports of standing are sent to adult students and to parents or guardians of students not of age.

EXPENSES.

TUITION:

The tuition is $150.00 per year, and must be paid in advance as follows: $75.00 on or before September 9, 1912, and $75.00 on or before January 27, 1913.

For one-half or any less fraction of the college year, the tuition is $75.00.

No rebate is allowed on tuition paid, but when a student is forced to withdraw from the Institute during a semester for valid reasons, the balance of the tuition representing that part of the semester for which he is absent may be redeemed in either the College, Summer, or Evening Class studies within one year from date of withdrawal from the Institute.

Students who withdraw from the Institute for two semesters or longer are considered new students upon re-entering and have to pay the same amount of tuition as new students.

TUITION FOR SERVICE RENDERED:

Any student desirous of earning his tuition must make written application in the Comptroller's Office on a furnished blank form at the beginning of each semester.

Application to render service for tuition will not be considered unless applicant has studied for *one year* in the Armour Institute of Technology.

Appointments are made by the Council at the beginning of each semester, *for one semester only.*

Under no circumstances will a student be allowed to earn his tuition for a longer period than four semesters.

FEES:

Late registration: Special attention is called to the fact that a fee of *one* dollar is charged for registration later than the day assigned for registration.

Students are expected to enroll in their classes within one day after registration. A fee of *one dollar per day* will be charged for failure to comply with the above ruling.

Non-payment in full: A fee of *one* dollar is charged also for the non-payment in full of all fees or deposits on registration day of each semester.

Shopwork: All students taking shopwork are required to pay a fee of *five* dollars per semester for each course.

Chemistry: Students in chemistry are charged a fee as follows:

For courses of four hours or less a week, *five* dollars per semester.

For courses of six hours or more a week, *seven and a half* dollars per semester.

Entrance Examination: Students required to take entrance examinations are charged a fee of *two* dollars.

Diploma Fees: For the degree of Bachelor of Science a fee of *five* dollars is charged. For the degree of Master of Science and for the professional degrees of Mechanical Engineer, Electrical Engineer, Civil Engineer, Chemical Engineer, and Fire Protection Engineer a fee of *ten* dollars is charged.

The fees are to be paid before the Commencement Day on which the degree is to be taken.

A fee of $2.00 is charged for duplicate records sent to students or former students of the Institute.

DEPOSITS:

A *laboratory* deposit of *ten* dollars is required of students in *Chemistry,* which is refunded, after a deduction for breakage, at the end of the year.

A deposit of *three* dollars is required of Junior and Senior students for the *use of the large drawing boards* at their disposal in the drafting rooms. This deposit is refunded to the student upon the return of the drawing board.

PAYMENTS:

No student is allowed to graduate until all fees due have been paid.

All payments should be made to *Mr. F. U. Smith, Comptroller, Armour Institute of Technology.*

LIBRARY.

The Library contains more than 27,000 volumes, and 4,000 pamphlets; 180 periodicals are taken, kept on file and bound. It is primarily a reference library for engineering students, but is also strong in science, history, literature, philosophy and economics. It is well supplied with current literature, including the transactions and proceedings of learned societies and the chief literary and scientific periodicals.

Direct access to the shelves of the Library is allowed to the students in order that they may better familiarize themselves with the use of the library.

An important feature of the work done by the Library staff is the valuable help offered to the various departments of instruction by the preparation of *Engineering Bibliographies.*

The Library is open daily from 8 A. M. to 5 P. M., and Monday, Tuesday, Thursday, and Friday, during the session of the evening classes, from 7 to 9:30 P. M.

PUBLICATIONS.

The Armour Engineer is a semi-annual *technical* publication, edited and managed by the student body of the Armour Institute of Technology.

The Fulcrum is a *monthly* publication, edited and managed by the students. It deals with Institute affairs, and also offers articles upon scientific and engineering topics, contributed by students, alumni, or members of the Faculty.

SCHOLARSHIPS AND PRIZES.

1. By the bequest of *Mrs. Catherine M. White, three scholarships* have been established, the recipients of which are to be selected by the President.

2. The *Rosewater Scholarship* was provided for in the will of the late Mr. E. Rosewater, for many years a distinguished editor of the "Omaha Bee," and is available under certain provisions to a young man from the Omaha city schools.

3. The *John H. Hamline Scholarship* was established by a number of his personal friends as a Memorial to this eminent lawyer and citizen and is available to the appointee of their committee under the advice of the President of the Institute.

4. Two scholarships known as the *Lolita Armour Scholarship* and the *Lester Armour Scholarship,* have been established by Mrs. J. Ogden Armour, and Mrs. P. A. Valentine, respectively. These scholarships are assigned under the direction of the Institute Council.

5. A scholarship is provided for the *Freshman* year in behalf of *an individual student from each High School in the City of Chicago.*

He must be a student who has graduated at the previous commencement of the High School which he represents. His selection for the use of this foundation will be made by the principal and faculty of the High School from which he comes.

The following factors must enter into the election of the student thus mentioned by the authorities of the High School:

First, the desirability of his receiving such help;

Second, his personal character;

Third, his scholarship.

6. In the course of the year 1909 there were established two scholarships whose foundation is the gift of *Mr. Bernard E. Sunny,* upon whom the Armour Institute of Technology conferred the honorary degree of *Doctor of Science* at the Commencement of 1908. These scholarships are awarded to deserving students by the Council of the Institute.

7. A medal, the gift of Charles L. Hutchinson. President of the Art Institute, is awarded each year to the student in the department of Architecture who has the best record for his four years' work.

8. A prize of $250.00 is given annually by the Art Institute to the winner of the Home Traveling Scholarship established to benefit students in the department of Architecture. This sum must be spent in travel in the United States or in Europe.

9. Prizes of $25.00 each are given to students of the department of Architecture for the best designs in terra cotta and ornamental iron.

10. Two prizes of $25.00 each are given annually by *Mr. Alfred S. Alschuler* of the Class of '99 for excellency in design. One of these prizes is awarded to a member of the Sophomore class and the other to a member of the Junior class.

SOCIETIES AND SOCIAL LIFE.

The scientific activities and the social life of the Institute are fostered by the organization of scientific, literary, musical societies, and fellowship clubs.

The several organizations elect their own officers and manage their own affairs, with the advice and consent of the Executive Council and the Faculty. It is believed that such organizations among students are important adjuncts to the development of the scientist and scholar.

The *scientific societies* organized by and under the direct control of the student body have for their object the preparation and discussion of papers upon engineering subjects.

The following scientific societies are organized:

American Institute of Electrical Engineers—Armour Branch;
Chemical Engineering Society;
Civil Engineering Society;
Mechanical Engineering Society.

There are four *fraternities* represented at the Armour Institute of Technology. Three of the fraternities have their own houses, in which their members live. The honor fraternity, Tau Beta Pi, has a chapter at Armour.

According to a ruling made by the Executive Council of the Armour Institute of Technology, no student shall be pledged by any fraternity during the first semester of the Freshman year, and shall not be initiated until he has acquired Sophomore standing in his studies.

The other societies comprise the Young Men's Christian Association, the Glee Club, the Mandolin Club, the Camera Club, and the Radical X Society.

(Concerning Chapin Club, see page 127.)

TEXT-BOOKS.

All text-books, drawing instruments, paper, and supplies, may be purchased at the office of the Registrar. The cost of material, including text-books, is from twenty to thirty-five dollars per year.

THESES.

Members of the Senior Class, who expect to graduate, shall declare, at the beginning of the Academic year, their intention to do so, in order that provision for removal of any deficiencies in their records may be made. No student is allowed to begin or assist in thesis work until all conditions in his studies have been removed, which shall not be later than the end of the first semester of the Senior year.

The subject of the thesis is agreed upon by the student and the professor in charge of the department in which the student is to graduate. The professor is requested to report the subject chosen to the Executive Council on or before February 1st of each year.

The thesis is to be typewritten, at the expense of the student, on appropriate paper, 8x10½ inches in size, properly paged, and also indexed when desirable. All drawings or diagrams are to be blue-printed, folded and bound as plates with text preceding.

It is at the discretion of the professor in charge of the department whether each student shall prepare a copy of the thesis, or whether one copy shall serve for a group of students.

The thesis must be handed to the professor in charge of the department not less than two weeks before Commencement. It is open for inspection in the office of the Deans to all members of the Faculty during one week before Commencement Day. The Executive Council reports to the Board of Trustees, through the President, the names of those students who are to receive degrees.

A copy of approved theses shall be deposited in the library as the property of the Institute, and a fee of *one* dollar is to be paid by the author or authors of such theses for the proper binding.

Copies of the General Information Bulletin, the Bulletins of the Evening Classes, and of the Summer Courses will be sent on application.

DEGREES.

Conferred at the Fifteenth Annual Commencement, May 25th, 1911, and Titles of Theses.

ENGINEERING DEGREES.

The degree of Mechanical Engineer was conferred upon

WILLIAM C. BRUBAKER,
(B. S. in Mechanical Engineering, Class of '06.)
GLENN B. DUNMORE,
(B. S. in Mechanical Engineering, Class of '07.)
JAMES HUSTON FELGAR,
(B. S. in Mechanical Engineering, Class of '05.)
SIDNEY VINCENT JAMES,
(B. S. in Mechanical Engineering, Class of '07.)
GARFIELD P. LENNARTZ,
(B. S. in Mechanical Engineering, Class of '05.)
CHARLES WOODWARD MORGAN,
(B. S. in Mechanical Engineering, Class of '08.)
LOUIS ALBERT PARADISE,
(B. S. in Mechanical Engineering, Class of '06.)
PATRICK JOHN SCOTT,
(B. S. in Mechanical Engineering, Class of '06.)
MAX SKLOVSKY,
(B. S. in Electrical Engineering, Class of '00.)
WILLIAM ROBERT WILSON,
(B. S. in Mechanical Engineering, Class of '06.)

The degree of Electrical Engineer was conferred upon

MILLARD GILMORE,
(B. S. in Electrical Engineering, Class of '07.)
JOSEPH HERMAN JACOBSON,
(B. S. in Electrical Engineering, Class of '08.)
HOWARD LEWIS KRUM,
(B. S. in Electrical Engineering, Class of '06.)
WILLIAM MATTHEWS,
(B. S. in Electrical Engineering, Class of '99.)
RUDOLPH A. MORRISON,
(B. S. in Electrical Engineering, Class of '07.)
HAROLD WILLIAM NICHOLS,
(B. S. in Electrical Engineering, Class of '08.)
JOHN EARL SAUNDERS,
(B. S. in Electrical Engineering, Class of '07.)
ERNEST LEROY WALLACE,
(B. S. in Electrical Engineering, Class of '02).

The degree of Civil Engineer was conferred upon

EDMUND A. PRATT,
(B. S. in Civil Engineering, Class of '07.)
EMILE J. SILVER,
(B. S. in Civil Engineering, Class of '04.)
CLARENCE URLING SMITH,
(B. S. in Mechanical Engineering, Class of '07.)
GEORGE D. TOMPKINS,
(B. S. in Civil Engineering, Class of '07.)
JOHN T. WALBRIDGE,
(B. S. in Civil Engineering, Class of '07.)

The degree of Chemical Engineer was conferred upon

CHESTER STEPHEN HEATH,
(B. S. in Chemical Engineering, Class of '07.)
BALTHASER HOFFMAN,
(B. S. in Chemical Engineering, Class of '07.)

DEGREE OF BACHELOR OF SCIENCE.

The degree of Bachelor of Science in Mechanical Engineering was conferred upon

HARRY NOBLE PARSONS,

DAVID GOLDBERG,
Thesis: Design and Installation of Apparatus for Determining Transmission Losses in a 40 H. P. Halladay, 1911, Chassis.

WILLIAM SIECK, JR.,
Thesis: Installation and Test of 7 H. P. De La Vergne Kerosene Engine.

JOHN ALVIN McCAGUE,

JOHN GRANT FENN,

CHARLES EDGAR BECK,
Thesis: Installation and Test of a Three-Ton Ice Plant.

FRANCIS HERBERT GRIFFITHS,

GEROME FRED CUMMINS,
Thesis: Efficiency Test of Blowers.

YOKE HIM CHAN,
Thesis: Construction and Calibration of a New Type of Pressure Gauge.

ROY BARTON AMBROSE,

J. ALBERT M. ROBINSON,
Thesis: Determination of the Effect of Varying the Amount of Moisture in a 40 H. P. Smith Anthracite Suction Gas Producer.

The degree of Bachelor of Science in Electrical Engineering was conferred upon

EVERETT DEE KAISER,

FRANK EDWARD MYERS,
Thesis: A Study of the Neutral Currents in a Three-phase star Connected Alternators and Transformers.

ISADORE GOLDBERG,

SOLOMON SACKHEIM,
Thesis: Comparative Tests of Some New Types of D. C. and A. C. Watt-Hour Meters.

WALTER OTTO HEITNER,

WILLIAM PATRICK McGUIRE,

ALFRED CARL LOHSE,
Thesis: Comparative Tests of the Mercury Arc and the Murphy Rectifiers.

ALFRED HERBERT PACKER,
Thesis: Design of a Prepayment Car for City Service.

ARTHUR MAX NEWHOUSE,

GERRY D. PETTIBONE,
Thesis: Design of Proposed Hydro-Electric Power Plant on Big Salmon River, Idaho.

EMIL JOHN SCHMIDT,
Thesis: The Methods of Public Utility Commissions Relating to Electric Light, Power, and Railway Companies.

PERCIVAL LORING BRADFORD,

JAMES HERBERT FLETCHER,
Thesis: Rotary Transformer for Direct Currents.

FRANK KONICEK, JR.,

OTTO ALBERT WITTE,
Thesis: Design of a 30,000 K. W. Steam Turbo-Generator Station for Detroit, Michigan.

LEONARD CARL ANDERSON,

JOHN HERBERT KUEHNE,
Thesis: Comparative Tests of Alkaline and Acid Types of Storage Batteries.

JOHN SIMPSON REID, JR.,
Thesis: Test of a Potassium Chlorate Signal Cell.

JOHN KENNETH MABBS,
Thesis: Efficiency Test of Mabbs Electric Elevators at the Chicago Board of Trade.

ROBERT HAY,
Thesis: Construction and Test of a Boucherot Induction Motor.

MARK E. GAULT,
Thesis: Tests on Enameled Wire.

WILLIAM GUSTAVE TELLIN,
Thesis: Design of a 20,000 K. W. Steam Turbo-Electric Power Plant.

EDWARD CHANDLER DOBBIE,

WALTER WHITE DREW,

GUY EUGENE WILLIAMS,

LYTLE LYTTON WILLIAMS,
Thesis: Tests of Electrical Machinery in the Plants of the Sanitary District of Chicago.

The degree of Bachelor of Science in Civil Engineering was conferred upon

TIRRELL JOHN FERRENZ,
Thesis: Design for Proposed Outer Harbor of City of Chicago.

OSCAR RAYMOND ERICKSON,
Thesis: Design of Highway Suspension Bridge over the Great Miami River, Dayton, Ohio.

CHARLES WILLIAM BINDER,

LOUIS SIMONS,

OTTO ROBERT KELLNER,
Thesis: Design of a 210-foot Spandrel Broad Two-Hinged Steel Arch over the Rio Fiscal.

RAYMOND RAYNOR ZACK,

IGNATIUS LEO SZESZYCKI,
Thesis: Design of Concrete Arch Dam.

CLAUDIO JOSE da SILVA,
Thesis: Plans and Profiles for Brick Pavement for Woodstock, Illinois.

SCHUYLER MORTON SMITH,

HORACE LUND BUTLER,
Thesis: Design of Ribbed Arch Spandrel Concrete Arch.

EMIL OLIN MANDLER,

RAYMOND FREDERICK JENSEN,

CHARLES HENRY MARX,
Thesis: Design of Reinforced Concrete Arch Bridge—Spandrel Arches.

GERSON HERBERT EMIN,

WILFRED RAY TOBIAS,

HERMAN LASKEY,
Thesis: Reinforced Concrete Beam Tests. Investigation of Bond Stress.

HARVEY WILLARD JONES,
Thesis: Design of Proposed Hydro-Electric Power Plant on Big Salmon River, Idaho.

WIRT ALLEN STEVENS,
Thesis: A Test of Slender Wooden Struts for Aeroplanes.

MEYER JOSHUA SALOMON,
Thesis: Design of a Reinforced Concrete Dam.

GEORGE BURKHARDT HILLS,

THANE GRIFFITH CLEAVER,
Thesis: Tests to Determine the Value of Concrete Waterproofing Compounds.

JOHN BARNETT JOHNSON,

PERCY ROY HYNES,

ALBERT ERNEST BREDLAU,
Thesis: Design of Trunnion Bascule Bridge.

The degree of Bachelor of Science in Chemical Engineering was conferred upon

HYMEN BORNSTEIN,
PHILIP FRANCIS MILLER,
Thesis: The Effect of Heat Treatment on Alloy Steels.
GEORGE VERNON GREEN,
HAROLD SAMUEL JOHNSON,
Thesis: Iodine and Potassium Salts from the Sea Weed.
GARRETT BELL JAMES,
HERBERT SIECK,
Thesis: Wood Tar: Its Properties and Utilization.

The degree of Bachelor of Science in Fire Protection Engineering was conferred upon

HAROLD MUNGER ALLING,
MILTON FOSKET DANIELS,
ROBERT KARL DOERING,
Thesis: Influence of Nozzle Design Upon Discharge Coefficients of Automatic Sprinklers.
FRED WILLIAM METZ,
WILLIAM WARREN MOORE,
WILLIAM EDWARD SCHULTZ,
Thesis: Time Factor of Dry Pipe Automatic Sprinkler Systems.

The degree of Bachelor of Science in Architecture was conferred upon

RALPH EMERSON SMALLEY,
Thesis: A Municipal Theater in a Capital City.
HAROLD A. MERRIMAN,
Thesis: Design for a Music Hall for a Western City.
HARRY ISRAEL DALSEY,
Thesis: A Synagogue.
RAPHAEL NATHAN FRIEDMAN,
Thesis: A Hotel in a Winter Resort.
RALPH LORING BEAUDRY,
Thesis: A Chicago Artists' Club.
BERNHARD CAMEN GREENGARD,
Thesis: A Residence for the President of the United States.

REGISTER OF STUDENTS.

SENIOR CLASS.

The following abbreviations are used to denote the different courses:

M. E.—Mechanical Engineering.
E. E.—Electrical Engineering.
C. E.—Civil Engineering.
Ch. E.—Chemical Engineering.
F. P. E.—Fire Protection Engineering.
A.—Architecture.
I. A.—Industrial Arts.

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Abrahamson, Oscar F.	E.E.	*Holdrege, Neb.*	4500 Indiana Ave.
Anderson, Seymour C.	C.E.	*Chicago, Ill.*	3501 Pierce Ave.
Andrew, J. M., Jr.	E.E.	*Louisville, Ky.*	4533 Prairie Ave.
Armstrong, Graham.	E.E.	*Bloemfontain, South Africa*	3325 Armour Ave.
Armstrong, Richard C.	E.E.	*Poolburn, Otago, New Zealand*	3339 Armour Ave.
Beach, William E.	C.E.	*Chicago, Ill.*	1021 Wells St.
Beerbaum, Arthur J.	M.E.	*Chicago, Ill.*	3353 Lincoln Ave.
Beifeld, Herbert A.	Ch.E.	*Chicago, Ill.*	5172 Michigan Ave.
Bloomfield, Julius C.	E.E.	*Chicago, Ill.*	1256 S. Kedzie Ave.
Bohlander, Harvey A.	M.E.	*Oak Park, Ill.*	409 Marion St., Oak Park, Ill.
Canman, Elmer L	M.E.	*Chicago, Ill.*	2026 Leland Ave.
Chandler, J. G. J.	C.E.	*Chicago, Ill.*	3024 Flournoy St.
Claar, Rufus S.	C.E.	*Blair, Neb.*	3336 Michigan Ave.
Clark, Ronald B.	C.E.	*Paris, France*	5404 Everett Ave.
Collins, Charles W.	C.E.	*Chicago, Ill.*	5338 Van Buren St.
Connell, Daniel	A.	*Toledo, Iowa*	3142 Michigan Blvd.
Curren, Earl L.	C.E.	*Aurora, Ill.*	Fraser Block, Aurora, Ill.
Dewalt, Edward V.	A.	*Chicago, Ill.*	435 Normal Parkway.
Dierking, Fred C.	C.E.	*Chicago, Ill.*	4131 N. Lawndale Ave.
Dormitzer, Henry C.	Ch.E.	*Chicago, Ill.*	7415 Harvard Ave.
Drew, Harvey A.	E.E.	*Downers Grove, Ill.*	144 N. Forest Ave. Downers Grove, Ill.
Dunn, Will C.	M.E.	*Chicago, Ill.*	1518 E. 65th St.
Enoshita, T.	E.E.	*Osaka, Japan*	7200 Jackson Park Ave.
Erickson, George C.	E.E.	*Chicago, Ill.*	3118 Indiana Ave.
Evans, Percy W.	E.E.	*Fort Worth, Tex.*	3142 Michigan Ave.
Garrison, Carl W.	C.E.	*Chicago, Ill.*	419 E. 46th Place.
Geisler, Rupert J.	C.E.	*Chicago, Ill.*	627 W. 64th St.
Graham, Frank A.	E.E.	*Mt. Hope, Kan.*	3314 Dearborn St.
Hazen, Fred G.	E.E.	*Rib Lake, Wis.*	6504 Parnell Ave.
Hess, Adolf, Jr.	C.E.	*Chicago, Ill.*	1353 Madison St.
Hoehn, J. Curtis.	Ch.E.	*Chicago, Ill.*	441 Oakdale Ave.
Holden, Edward C.	C.E.	*Chicago, Ill.*	5062 Kenmore Ave.
Holtman, Dudley L.	C.E.	*Chicago, Ill.*	4243 Langley Ave.
Kahn, Sidney	Ch.E.	*Chicago, Ill.*	4547 Indiana Ave.
Keachie, Paul L.	M.E.	*Chicago, Ill.*	7142 Parnell Ave.
Keeler, Harry S.	E.E.	*Chicago, Ill.*	740 N. State St.
Kiley, L. D.	M.E.	*Chicago, Ill.*	3227 Groveland Ave.
Kimball, N. F.	M.E.	*Oshkosh, Wis.*	3416 Calumet Ave.
Kornfeld, Leo P.	C.E.	*Chicago, Ill.*	5948 Throop St.
Langstaff, Harold P.	E.E.	*Blair, Neb.*	3316 Dearborn St.
Lawrence, M. F.	M.E.	*Chicago, Ill.*	5733 Monroe Ave.

SENIOR CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Legel, John G.	A.	*Charles City, Ia.*	5803 Calumet Ave.
Leichenko, Peter M.	C.E.	*Odessa, Russia*	2141 Evergreen Ave.
Leviton, Morton I.	A.	*Chicago, Ill.*	1837 Evergreen Ave.
Lewis, George D., Jr.	C.E.	*Evanston, Ill.*	3142 Michigan Ave.
Ligare, George	M.E.	*Glencoe, Ill.*	
Lindberg, William A.	E.E.	*Chicago, Ill.*	2702 East 76th Place.
Loewenberg, Max L.	C.E.	*Chicago, Ill.*	1005 South Paulina St.
Mack, Frank J.	C.E.	*Chicago, Ill.*	3301 West 12th St.
Malzen, M.	C.E.	*Chicago, Ill.*	12140 Eggleston Ave.
Martin, W. G.	E.E.	*Chicago, Ill.*	5323 Greenwood Ave.
Meade, G. Raymond.	E.E.	*Chicago, Ill.*	1516 South Kedzie Ave.
Michael, John, Jr.	E.E.	*Chicago, Ill.*	4418 North Paulina St.
Moore, Milburn	M.E.	*Chicago, Ill.*	3142 Michigan Ave.
Narozny, Joseph S.	C.E.	*Chicago, Ill.*	4829 S. Wood St.
Ness, Charles	Ch.E.	*Chicago, Ill.*	373 Kensington Ave.
Neufeld, Ralph	C.E.	*Chicago, Ill.*	5017 Grand Blvd.
Newman, Joseph J.	Ch.E.	*Chicago, Ill.*	4812 Indiana Ave.
Noren, Harry E.	E.E.	*Chicago, Ill.*	1044 Montana St.
Oehne, Walter	C.E.	*Chicago, Ill.*	5401 Ellis Ave.
Pagliarulo, Vincent.	E.E.	*Chicago, Ill.*	3213 Michigan Ave.
Pasimansky, H. E.	E.E.	*Chicago, Ill.*	6500 Green St.
Peck, Winfield	M.E.	*Chicago, Ill.*	2254 Michigan Ave.
Peiser, Marcus A.	C.E.	*Chicago, Ill.*	4623 Prairie Ave.
Piper, Ellsworth E.	i.A.	*Chicago, Ill.*	3521 S. Hermitage Ave.
Pirrie, Peter G.	Ch.E.	*Chicago, Ill.*	4801 E. Ravenswood Pk.
Ratkowski, Edward P.	C.E.	*Chicago, Ill.*	1252 Noble St.
Roleson, Edward P.	Ch.E.	*Forest City, Ark.*	6256 Stoney Island Ave.
Roller, Louis H.	E.E.	*Chicago, Ill.*	6224 Greenwood Ave.
Ross, Ralph R.	E.E.	*Blair, Neb.*	3316 Dearborn St.
Ruef, John E.	M.E.	*Dixon, Ill.*	6044 Michigan Ave.
Rylander, Paul	C.E.	*Chicago, Ill.*	852 N. Central Ave.
Schmidt, Fred	C.E.	*Chicago, Ill.*	1639 S. Trumbull Ave.
Schommer, John J.	Ch.E.	*Chicago, Ill.*	4338 Perry St.
Schuler, Charles R.	E.E.	*Chicago, Ill.*	2135 Leland Ave.
Sincere, Edwin M.	A.	*Chicago, Ill.*	4744 Prairie Ave.
Snow, C. A.	F.P.E.	*Chicago, Ill.*	5459 Cornelia St.
Spindler, R. W.	C.E.	*Chicago, Ill.*	3976 Lake Ave.
Steward, Wm. H. Jr.	M.E.	*Louisville, Ky.*	3249 Wabash Ave.
Strale, Nels W.	M.E.	*Chicago, Ill.*	1533 E. 65th St.
Strong, Paul A.	E.E.	*Oak Park, Ill.*	138 S. Scoville Ave. Oak Park, Ill.
Swanson, W. Robert.	C.E.	*Chicago, Ill.*	216 Garfield Blvd.
Todt, S. R.	E.E.	*Arcola, Ill.*	3142 Michigan Ave.
Turley, Everett W.	Ch.E.	*Chicago, Ill.*	1038 E. 46th St.
Wamsley, Gage R.	C.E.	*Chicago, Ill.*	27 E. Garfield Blvd.
Whitaker, Dwight A.	E.E.	*Bradentown, Fla.*	3315 Vernon Ave.
White, Loyal R.	E.E.	*Lena, Ill.*	4035 Lake Ave.
Wolfe, Thomas F.	C.E.	*Chicago, Ill.*	7048 Vincennes Ave.
Yoshida, Henry T.	M.E.	*Tokyo, Japan*	3200 Calumet Ave.

JUNIOR CLASS.

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Adams, George M	C.E.	*Buffalo, Wyo*	3336 Michigan Ave.
Ahlvin, Martin V	C.E.	*Joliet, Ill*	1000 S. Irving St. Joliet, Ill.
Anderson, George A	C.E.	*Chicago, Ill*	6821 Loomis St.
Arenberg, Albert L	E.E.	*Chicago, Ill*	5714 Calumet Ave.
Arnold, C. Harry	C.E.	*Chicago, Ill*	5959 Calumet Ave.
Arp, Walter B	E.E.	*Sherburn, Minn*	321 E. 43rd St.
Badger, Orville C	C.E.	*Niles, Mich*	3346 S. Park Ave.
Bangs, Fred T	E.E.	*Minneapolis, Minn.*	3318 Dearborn St.
Bischoff, Jacob H	A.	*Chicago, Ill*	5548 Drexel Ave.
Bradford, J. Dudley	M.E.	*Jackson, Miss*	6231 Greenwood Ave.
Braun, Wm. T. Jr	A.	*Chicago, Ill*	325 W. 59th Place.
Brown, Clarence M	A.	*Monroeville, Ind*	3329 Armour Ave.
Brown, Paul K	M.E.	*Chicago, Ill*	7036 Princeton Ave.
Burley, E. Roger Jr	M.E.	*Chicago, Ill*	5463 Madison Ave.
Buttner, William C	Ch.E.	*Chicago, Ill*	1226 Montana St.
Cooper, Howard	M.E.	*Chicago, Ill*	6056 Madison Ave.
Copenhaver, Philip A	E.E.	*Chicago, Ill*	324 N. Normal Parkway.
Cramer, August C	C.E.	*Chicago, Ill*	3715 Osgood St.
Crow, Ralph M	A.	*Chicago, Ill*	6700 South Green St.
Crowell, Charles H., Jr.	E.E.	*Chicago, Ill*	4731 Prairie Ave.
Culp, Carl B	C.E.	*Chicago. Ill*	6939 Michigan Ave.
Curtis, Marston	E.E.	*Chicago, Ill*	5539 Monroe Ave.
Drozeski, Donald A	M.E.	*Evanston, Ill*	707 Forest Ave., Evanston, Ill.
Ehrman, Joseph S	E.E.	*Chicago, Ill*	3321 W. Adams St.
Ermeling, Ralph W	A.	*Chicago, Ill*	567 North 53rd Ave.
Fallon, Emmett J	C.E.	*Chicago, Ill*	4936 Champlain Ave.
Farrelly, J. Leo	C.E.	*Chicago, Ill*	12120 Halsted St.
Faulkner, Charles D	A.	*Chicago, Ill*	7157 Yale Ave.
Fernandez, Francis	E.E.	*Asuncion, Para'y*	3249 S. Park Ave.
Fischel, Rudolph E	E.E.	*Chicago, Ill*	4939 Calumet Ave.
Fjeldseth, John T	C.E.	*Baltimore, Md*	932 Rush St.
Fleming, Matthew J	C.E.	*Chicago, Ill*	4021 Calumet Ave.
Ford, George F	C.E.	*Chicago, Ill*	9828 Winston Ave.
Fors, Adolf F	M.E.	*Chicago, Ill*	6206 Peoria St.
Fraser, Jesse G	A.	*Chicago, Ill*	3001 Calumet Ave.
Fryburg, Warren	E.E.	*Great Falls, Mont.*	3408 S. Park Ave.
Furay, Connell J	A.	*Omaha, Neb*	3346 Dearborn St.
Galbraith, Jack	C.E.	*Chicago, Ill*	6648 Harvard Ave.
Gibbs, Archbald D	A.	*Princeton, Ill*	3539 Grand Blvd.
Greifenhagen, Paul	C.E.	*Chicago, Ill*	475 Deming Place.
Hager, Emil A	E.E.	*Pueblo, Colo*	3312 Dearborn St.
Hamilton, Don W	A.	*Chicago, Ill*	6216 Kimbark Ave.
Hamilton, David W	A.	*Chicago, Ill*	6216 Kimbark Ave.
Hansen, J. Henry	F.P.E.	*Long Island, N.Y.*	3336 Michigan Ave.
Hayes, James J., Jr	M.E.	*Chicago, Ill*	4401 Greenwood Ave.
Herman, B. J	A.	*Chicago, Ill*	2602 Twenty-fifth St.
Himelblau, A	A.	*Chicago, Ill*	910 Winthrop Court.
Hoffman, E. Louis	E.E.	*Chicago, Ill*	407 E. 115th St.
Holden, A. F., Jr	F.P.E.	*Oak Park, Ill*	644 N. Elmwood Ave., Oak Park, Ill.

JUNIOR CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Hoven, Roy	Ch.E.	*Chicago, Ill.*	6350 Sangamon St.
Ingram, H. D. F	C.E.	*Florence, Wis*	3137 Cottage Grove Ave.
Irving, George F	M.E.	*Chicago, Ill.*	4440 N. Winchester Ave.
Israel, Henry F	C.E.	*Chicago, Ill.*	5334 Union Ave.
Jarvis, Brewster H	M.E.	*Chicago, Ill.*	5346 Drexel Ave.
Johnson, P. O. E	M.E.	*Chicago, Ill.*	7034 Perry Ave.
Kehr, Charles F	M.E.	*Dixon, Ill*	3706 Grand Blvd.
Knaus, Peter J	Ch.E.	*Chicago, Ill.*	2446 Orchard St.
Koch, Raymond J	C.E.	*Chicago, Ill.*	539 Oakdale Ave.
Kuehn, H. R	M.E.	*Chicago, Ill.*	1521 South Hamlin Ave.
Langill, Elwood O	C.E.	*Chicago, Ill.*	1049 Wells St.
Larson, Clifford M	M.E.	*Chicago, Ill.*	5743 Kimbark Ave.
Lautz, William H., Jr	A.	*Chicago, Ill.*	3020 Butler St.
Leibrandt, Charles R	C.E.	*Chicago, Ill.*	5312 Indiana Ave.
Lill, Arthur C	E.E.	*Chicago, Ill.*	2983 Archer Ave.
Lindquist, Joseph B	A.	*Chicago, Ill.*	3923 Grand Blvd.
Lucas, John T	C.E.	*Chicago, Ill.*	3254 Lowe Ave.
Lundberg, Joseph	C.E.	*Chicago, Ill.*	1152 West 59th St.
Lundblad, Claus D	A.	*Chicago, Ill.*	7257 Perry Ave.
Mann, William C	E.E.	*Davenport, Iowa*	4512 N. Lincoln St.
Marx, Walter L	Ch.E.	*Chicago, Ill.*	957 Webster Ave.
Meyer, Philip	C.E.	*Chicago, Ill.*	1206 West 12th St.
Moore, Fontenelle	Ch.E.	*Chicago, Ill.*	5200 Kimbark Ave.
Munn, William K	Ch.E.	*Boise, Idaho*	3316 Dearborn St.
Newman, Irwin	M.E.	*Chicago, Ill.*	4337 Vincennes Ave.
Opper, George L	C.E.	*Riverside, Ill*	
Paszkiewicz, Joseph A	E.E.	*Chicago, Ill.*	1248 Noble St.
Philleo, Leigh H	M.E.	*Vinton, Iowa*	6626 Kimbark Ave.
Phillips, Bernard	C.E.	*Pullman, Ill*	10638 Fulton Ave., Pullman, Ill.
Pitts, Guy C	C.E.	*Chicago, Ill.*	6622 Ingleside Ave.
Redlich, R., Jr	M.E.	*Chicago, Ill.*	2219 Dayton St.
Rietz, Elmer W	E.E.	*Chicago, Ill.*	560 Hawthorne Place.
Robertson, Alexander F	M.E.	*Chicago, Ill.*	451 North Harding Ave.
Rothwell, Richard F	C.E.	*Chicago, Ill.*	2529 Adams St.
Salzman, Abraham L	A.	*Chicago, Ill.*	1521 Edgemont Ave.
Schmieman, Oscar	M.E.	*Ft. Wayne, Ind*	3312 Dearborn St.
Schuette, Adolph J	Ch.E.	*Chicago, Ill.*	3950 N. Ashland Ave.
Semerak, Alfred W	M.E.	*Chicago, Ill.*	1669 Blue Island Ave.
Spencer, Charles H	M.E.	*Chicago, Ill*	429 East 45th Place.
Stansel, Walter G	E.E.	*Yorkville, Ill*	3346 S. Park Ave.
Steindler, Julius	A.	*Chicago, Ill.*	1261 Dearborn Ave.
Stewart, John L	C.E.	*Chicago, Ill.*	6840 Langley Ave.
Stump, Dan M	M.E.	*Chicago, Ill.*	4105 21st St.
Swanson, Frank A	E.E.	*Chicago, Ill.*	3138 Calumet Ave.
Tong, M. I	M.E.	*China*	2334 W. Madison St.
Trujillo, Felix A	C.E.	*Havana, Cuba*	48 W. 34th St.
VanderKieft, Nicholas	M.E.	*West Olive, Mich.*	6125 Ellis Ave.
Wald, Max D	M.E.	*Chicago, Ill.*	1419 E. 55th St.
Walin, Herbert S	C.E.	*Chicago, Ill.*	7421 Harvard Ave.
Wallace, Hugh	E.E.	*Van Wert, O*	3138 Calumet Ave.
Walsh, Raymond L	E.E.	*Chicago, Ill.*	3763 Rhodes Ave.
Wares, J. C	M.E.	*Chicago, Ill.*	11333 Prairie Ave.

JUNIOR CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Westlund, Edwin G.	C.E.	*Chicago, Ill.*	2259 California Ave.
Williams, Roscoe D.	C.E.	*Chicago, Ill.*	7123 South Chicago Ave.
Willson, Hubert E.	M.E.	*Anselmo, Neb.*	4630 Calumet Ave.
Wilson, Lester T.	Ch.E.	*Chicago, Ill.*	6029 Lincoln St.
Wintercorn, John, Jr.	M.E.	*Chicago, Ill.*	125 West 110th Place.
Woerner, Arthur.	A.	*Chicago, Ill.*	4113 N. Ashland Ave.
Wood, John.	C.E.	*Chicago, Ill.*	3341 Pierce Ave.
Yorke, William H.	M.E.	*Chicago, Ill.*	436 East 45th St.
Ziehn, R. Sebastian.	Ch.E.	*Chicago, Ill.*	172 Eugenie St.
Zillmer, Emil G.	A.	*Marion, Wis.*	3329 Armour Ave.

SOPHOMORE CLASS.

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Aeberly, John	C.E.	*Chicago, Ill.*	325 Eugenie St.
Agazim, Toly.	Ch.E.	*Chicago, Ill.*	1428 N. Maplewood Ave.
Agee, Polk Watkins	A.	*Helena, Ark.*	3336 Michigan Ave.
Altman, Eugene E.	C.E.	*Chicago, Ill.*	1439 East 66th St.
Asada, T. J.	E.E.	*Izushi, Japan*	3200 Calumet Ave.
Auer, P. Fenton.	C.E.	*Ft. Worth, Tex.*	3614 Indiana Ave.
Baker, Harry W.	F.P.E.	*Chicago, Ill.*	4722 Sheridan Road.
Balch, Harold C.	A.	*Neillsville, Wis.*	3416 Calumet Ave.
Barber, Gordon S.	A.	*Superior, Wis.*	58 West 34th St.
Barr, Allan W.	A.	*Chicago, Ill.*	4151 Perry St.
Beckley, Harry E.	E.E.	*Riverside, Ill.*	
Blanding, Harry O.	A.	*Corsicana, Tex.*	3414 Indiana Ave.
Boetter, Carl	C.E.	*Chicago, Ill.*	3220 Prairie Ave.
Bolton, Thomas C.	E.E.	*Sioux City, Ia.*	3142 Michigan Ave.
Brewer, Fred L., Jr.	M.E.	*Blue Island, Ill.*	224 Burr Oak Ave.
Broyles, John Lewis.	E.E.	*Savannah, Tenn.*	3159 Wentworth Ave.
Buchinskas, John	Ch.E.	*Chicago, Ill.*	2336 South Oakley Ave.
Burnham, C. L.	E.E.	*Chicago, Ill.*	4942 Washington Ave.
Burris, Edward	E.E.	*Chicago, Ill.*	2852 W. Polk St.
Carnahan, Glen	Ch.E.	*Compton, Ill.*	6338 Jackson Ave.
Carver, Allan Leonard.	Ch.E.	*Chicago, Ill.*	7122 Stewart Ave.
Case, Harry L.	E.E.	*Chicago, Ill.*	736 East 44th St.
Charlton, John R.	E.E.	*Chicago, Ill.*	5504 Iowa St.
Christensen, Erwin O.	A.	*Chicago, Ill.*	1435 East 60th St.
Clarke, George T.	A.	*Chicago, Ill.*	3152 Prairie Ave.
Clarke, H. Glen.	C.E.	*Chicago, Ill.*	7354 Lafayette Ave.
Cohen, Joseph	A.	*Chicago, Ill.*	1241 Johnson St.
Cohn, James W.	E.E.	*Chicago, Ill.*	1811 S. Troy St.
Cole, Robert M.	Ch.E.	*Glenview, Ill.*	
Compton, Faye Neil.	C.E.	*Chicago, Ill.*	5740 Midway Park.
Corbet, Clinton L.	C.E.	*Chicago, Ill.*	5638 Washington Ave.
Coulson, George C.	A.	*Sioux City, Ia.*	3341 Armour Ave.
Cunliffe, Russell W.	Ch.E.	*Milwaukee, Wis.*	48 W. 34th St.
Dames, Erwin	M.E.	*Chicago, Ill.*	650 Wellington St.
Dean, Charles Abbott.	C.E.	*Chicago, Ill.*	5809 Ontario St.
DeCelle, Oliver A.	Ch.E.	*Chicago, Ill.*	5310 Indiana Ave.
Deitenbeck, Max	C.E.	*Hohenlimburg, Germany*	3325 Armour Ave.
Dewson, John R.	E.E.	*Chicago, Ill.*	67 Washington Place.

SOPHOMORE CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Dilling, Albert W.	E.E.	*Chicago, Ill.*	1928 N. Sawyer Ave.
Dixon, Harry L.	C.E.	*Durango, Cal.*	5342 Washington Ave.
Doan, Leslie A.	C.E.	*Chicago, Ill.*	2519 South 42nd Ave.
Donaldson, Robert C.	M.E.	*Chicago, Ill.*	7202 Jackson Park Ave.
Dreffein, Fred P.	M.E.	*Chicago, Ill.*	217 S. Lombard Ave., Oak Park, Ill.
Dumke, William	E.E.	*Chicago, Ill.*	1616 S St. Louis Ave.
Earl, Ralph	M.E.	*New Orleans, La.*	1371 East 50th St.
Edlund, Lawrence L.	E.E.	*Chicago, Ill.*	1004 West 59th St.
Ehrlich, Walter	E.E.	*Chicago, Ill.*	5333 Halsted St.
Eldridge, Frank L.	F.P.E.	*Topeka, Kan.*	3330 Dearborn St.
Eliel, A. G.	A.	*Chicago, Ill.*	1342 Norwood St.
Ellison, Linnaeus R.	M.E.	*Chicago, Ill.*	326 N. Willow Ave., Oak Park, Ill.
Emslie, John M.	C.E.	*Chicago, Ill.*	7404 Harvard Ave.
Erickson, Harry Elmer.	M.E.	*Chicago, Ill.*	7409 Evans Ave.
Farrar, Fred D.	A.	*Cadillac, Mich.*	3416 Calumet Ave.
Fennessy, Thomas J.	A.	*Chicago, Ill.*	2998 Archer Ave.
Finkelstein, Leo	Ch.E.	*Chicago, Ill.*	830 Lowell Place.
Finlayson, Solomon S.	C.E.	*Nassau, Bahama Island*	3632 Dearborn St.
Garbulsky, Simon	C.E.	*Chicago, Ill.*	210 Seeley Ave.
Gielow, Walter C.	F.P.E.	*Manitowoc, Wis.*	1231 Newport Ave.
Gleason, Charles Egbert.	M.E.	*Kalamazoo, Mich.*	3336 Michigan Ave.
Goetz, O.	E.E.	*Chicago, Ill.*	2319 Orchard St.
Goetz, William	M.E.	*Chicago, Ill.*	3730 Rokeby St.
Goldman, E. R.	C.E.	*Rockford, Ill.*	52 W. 34th St.
Gumpper, Harold D.	M.E.	*Ft. Wayne, Ind.*	3336 Michigan Ave.
Hahn, George A.	Ch.E.	*West Chicago, Ill.*	
Hale, Leonard O.	A.	*Grinnell, Ia.*	3416 Calumet Ave.
Hallstein, Walter H.	C.E.	*Chicago, Ill.*	745 West North Ave.
Halperin, Casriel	A.	*Chicago, Ill.*	1533 W. Taylor St.
Hamilton, Warren H.	C.E.	*Omaha, Neb.*	3142 Michigan Ave.
Hathaway, R. Miller.	Ch.E.	*Owensboro, Ky.*	3337 Armour Ave.
Heeren, Arthur	C.E.	*Chicago, Ill.*	6135 Peoria St.
Heim, Richard M.	E.E.	*Chicago, Ill.*	3600 Cottage Grove Ave.
Hendrickson, Earl	C.E.	*Hutchinson, Kan.*	1114 East 62d St.
Hepp, Emil J.	F.P.E.	*Chicago, Ill.*	4349 Lake Ave.
Heritage, Clark C.	Ch.E.	*Chicago, Ill.*	5709 Midway Park, Austin, Ill.
Hetherington, Murray D.	A.	*Chicago, Ill.*	9236 Winchester Ave.
Hibbard, Lewis E.	M.E.	*Chicago, Ill.*	815 Oakdale Ave.
Himelblau, Harry	M.E.	*Chicago, Ill.*	910 Winthrop Court.
Hirsh, Louis	Ch.E.	*Ismail, Russia*	1225 W. Taylor St.
Hirshfield, Harry	C.E.	*Chicago, Ill.*	2133 Crystal St.
Hollowed, John	C.E.	*Chicago, Ill.*	3717 Lexington St.
Holmboe, Jens A.	C.E.	*Crookston, Minn.*	6213 Greenwood Ave.
Holzheimer, Charles J.	E.E.	*Chicago, Ill.*	549 E. 50th St.
Hook, Frank.	Ch.E.	*Ottumwa, Iowa.*	4714 Calumet Ave.
Hook, Leonard D.	C.E.	*Grays Lake, Ill.*	4714 Calumet Ave.
Hutchinson, Oliver K.	E.E.	*Glencoe, Ill.*	3741 Indiana Ave.
Jacobson, A. N.	C.E.	*Chicago, Ill.*	6526 Lowe Ave.
Jedamske, Herbert E.	C.E.	*Chicago, Ill.*	3431 N. Troy St.

SOPHOMORE CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Jensen, Lothardt	A.	*Omaha, Neb.*	58 W. 34th St.
Johnson, Alfred H.	M.E.	*Chicago, Ill.*	3348 South Park Ave.
Johnson, Victor E.	C.E.	*Chicago, Ill.*	530 West 60th Place.
Jucker, John	C.E.	*Chicago, Ill.*	5546 Drexel Ave.
Kann, William	C.E.	*Chicago, Ill.*	1010 West 69th St.
King, Kenneth T.	Ch.E.	*Chicago, Ill.*	532 North Pine Ave.
Kirk, Arthur M.	C.E.	*Chicago, Ill.*	6733 Vincennes Ave.
Kling, Olaf Emil.	M.E.	*Chicago, Ill.*	1231 N. Maplewood Ave.
Koch, Albert N.	M.E.	*Chicago, Ill.*	539 Oakdale Ave.
Koenigsberg, Nathan	A.	*Chicago, Ill.*	1410 Milwaukee Ave.
Kopald, Charles	M.E.	*Dubuque, Ia.*	3607 Indiana Ave.
Kujawski, Edward S.	A.	*Chicago, Ill.*	1700 West 17th St.
Lang, Eugene C.	E.E.	*Chicago, Ill.*	3531 Jackson Boulevard.
Lesser, David B.	Ch.E.	*Chicago, Ill.*	3403 Prairie Ave.
Lindblad, Alfred G.	A.	*Chicago, Ill.*	4100 West 20th St.
McCormick, John H.	Ch.E.	*West Bend, Wis.*	3602 Cottage Grove Ave.
McElligott, William P.	C.E.	*Chicago, Ill.*	105 W. 116th St.
Mackenzie, John D.	Ch.E.	*Chicago, Ill.*	4640 Drexel Boulevard.
Maddox, Herbert H.	A.	*Shreveport, La.*	3416 Calumet Ave.
Matt, Paul	E.E.	*Chicago, Ill.*	3500 South Western Ave.
Menke, Edward	M.E.	*Chicago, Ill.*	235 West 112th Place.
Meyer, Leslie C.	M.E.	*Oak Park, Ill.*	305 S. Austin Ave., Oak Park, Ill.
Moeller, Arthur	C.E.	*Chicago, Ill.*	221 West 57th St.
Moore, Victor H.	M.E.	*Helena, Ark.*	3318 Dearborn St.
Morrison, Earl W.	A.	*Spokane, Wash.*	908 Belden Ave.
Mosser, Robert H.	C.E.	*Palatine, Ill.*	
Moy, B. T.	E.E.	*Milwaukee, Wis.*	1356 E. 62nd St.
Nadel, Jerome S.	A.	*Chicago Hts., Ill.*	
Nelson, Edward L.	E.E.	*Chicago, Ill.*	5817 Jackson Ave.
Nertney, Harold F.	A.	*Ottawa, Ill.*	316 North Park Ave.
Norton, Joseph C.	C.E.	*Farmington, Ill.*	3142 Michigan Ave.
Oldenburger, William	E.E.	*Chicago, Ill.*	9129 Ontario Ave.
Perlstein, Harris	Ch.E.	*Chicago, Ill.*	812 Leland Ave.
Pomerene, Joel	C.E.	*Chicago, Ill.*	1411 Belle Plaine Ave.
Pond, Franklin L.	E.E.	*Chicago, Ill.*	6109 Madison Ave.
Pynchon, Edwin A.	C.E.	*Sheldon, Ia.*	3416 Calumet Ave.
Rauschert, Emil P.	E.E.	*Lake Mills, Wis.*	4213 N. Ashland Ave.
Reily, Alva E.	A.	*Marshfield, Wis.*	6314 Stoney Island Ave.
Rhoades, Roy S.	Ch.E.	*Casper, Wyo.*	3336 Michigan Ave.
Roberts, W. F.	E.E.	*Lyons, Canada*	50 West 34th St.
Roller, Herman D.	A.	*Chicago, Ill.*	6224 Greenwood Ave.
Rosenstiel, E.	E.E.	*Chicago, Ill.*	5018 Michigan Ave.
Rydell, Flavius W.	C.E.	*Chicago, Ill.*	5147 Michigan Ave.
Schell, Albert West.	F.P.E.	*Cincinnati, Ohio*	7141 Yale Ave.
Schmidt, Clarence G.	A.	*Portland, Ore.*	2823 Logan Blvd.
Schoembs, Arthur F.	E.E.	*Cairo, Ill.*	3118 Indiana Ave.
Sevin, Mandel I.	C.E.	*Chicago, Ill*	1849 W. Taylor St.
Sexsmith, Harold O.	A.	*Tacoma, Wash.*	831 W. 33rd Place.
Shane, James L.	A.	*Chicago, Ill.*	369 East 31st St.
Shnable, Barnes D.	E.E.	*Chicago, Ill.*	3336 Michigan Ave.
Siedenstrang, Otto	C.E.	*Union, Ill.*	2612 Homer St.
Simpson, Dudley E.	E.E.	*Chicago, Ill.*	5483 East End Blvd.

SOPHOMORE CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Sir, Walter W.	M.E.	*Chicago, Ill.*	3253 Butler St.
Smith, Harold F.	C.E.	*Chicago, Ill.*	1808 North Park Ave.
Smith, Harold J.	C.E.	*Yankton, S. D.*	3142 Michigan Ave.
Somers, Leslie V.	F.P.E.	*Grinnell, Iowa*	3416 Calumet Ave.
Stanley, Harry Cadet.	A.	*Chicago, Ill.*	1451 East 56th St.
Stecher, Melville V.	E.E.	*Oak Park, Ill.*	407 N. Humphrey Ave.
Stein, Ed.	A.	*Fredericksburg, Tex.*	4053 Calumet Ave.
Steininger, Walter	C.E.	*Chicago, Ill.*	3940 Calumet Ave.
Swartz, Charles H.	E.E.	*Chicago, Ill.*	3715 W. Indiana St.
Swatek, George W.	E.E.	*Chicago, Ill.*	1415 N. State St.
Turner, John Wallace.	E.E.	*Chicago, Ill.*	7752 Green St.
Unseld, H. Frederick.	A.	*Chicago, Ill.*	4808 Wabash Ave.
Valerio, Francis M.	A.	*LaGrange, Ill.*	R. F. D. 29, LaGrange, Ill.
Vesely, John C.	C.E.	*Chicago, Ill.*	1320 S. Central Pk. Ave.
Vittner, Clement	A.	*Chicago, Ill.*	2420 S. Clifton Pk. Ave.
Walker, Bert H.	M.E.	*Newton, Kan.*	48 W. 34th St.
Walker, Stephen P.	C.E.	*Chicago, Ill.*	35 W. 33d St.
Walther, Charles B.	C.E.	*Chicago, Ill.*	915 Lyman Ave.
Wetzel, Clarence L.	E.E	*Braymer, Mo.*	3312 Dearborn St.
Whipple, John G.	E.E.	*Waukegan, Ill.*	3336 Michigan Ave.
White, Austin G.	M.E.	*Chicago, Ill.*	6800 Perry Ave.
Whitmore, Robert W.	E.E.	*S. Milwaukee, Wis.*	3118 Indiana Ave.
Whittington, J. Albert.	C.E.	*Benton, Ill.*	48 W. 34th St.
Wilensky, Meyer	C.E.	*Chicago, Ill.*	915 S. Wood St.
Wilson, John W.	M.E.	*St. Charles, Ill.*	74 Fulton St., St. Charles, Ill.
Wishnick, Isadore	F.P.E.	*Mokena, Ill.*	
Wolfley, Chester E.	A.	*Rockford, Ill.*	52 W. 34th St.
Wood, Clarence F.	A.	*Charlevoix, Mich.*	7220 Constance Ave.
Wright, Chester F.	E.E.	*Waterloo, Iowa*	3338 Armour Ave.
Wright, J. C.	A.	*South Bend, Ind.*	6054 Jefferson Ave.
Yonkman, William	Ch.E.	*Chicago, Ill.*	10850 Wentworth Ave.
Zack, Edgar G.	C.E.	*Shelby, Neb.*	3360 Prairie Ave.
Zavertnik, Joseph, Jr.	Ch.E.	*Chicago, Ill.*	2821 S. 40th Ave.
Zeman, Leonard	C.E.	*Chicago, Ill.*	3402 Vernon Ave.
Zook, Roscoe	A.	*Ft. Wayne, Ind.*	3416 Calumet Ave.

FRESHMAN CLASS

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Adamson, F. F.	E.E.	*Sioux City, Iowa*	3314 Dearborn St.
Agee, Jess A.	M.E.	*Chicago, Ill.*	4559 Greenwood Ave.
Anderson, Oscar A.	M.E.	*Chicago, Ill.*	5618 Emerald Ave.
Anderson, Stanley W.	E.E.	*Chicago, Ill.*	7835 Muskegon Ave.
Anning, Harold E.	C.E.	*Chicago, Ill.*	927 Lafayette Parkway.
Arcus, H. G.	A.	*Chicago, Ill.*	9732 Howard Court.
Armstrong, Fred C.	E.E.	*Chicago, Ill.*	1379 East 53rd St.
Badger, Volney P.	Ch.E.	*Perry, N. Y.*	1716 East 55th St.
Barnett, Israel.	Ch.E.	*Chicago, Ill.*	1345 North Oakley Ave.
Bartling, George R.	A.	*Grand Island, Neb.*	37 West 33rd St.
Bassett, Donald M.	Ch.E.	*Chicago, Ill.*	6931 Harvard Ave.

FRESHMAN CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Beach, A. Blaine	E.E.	*Chicago, Ill.*	4762 Wentworth Ave.
Benton, Grant	Ch.E.	*Chicago, Ill.*	6917 Parnell Ave.
Bodholdt, Arne	A.	*Waterloo, Iowa*	6743 Loomis St.
Bohn, Robert G.	M.E.	*Grand Island, Neb.*	3312 Dearborn St.
Bokman, Arthur	M.E.	*Chicago, Ill.*	9032 Exchange Ave.
Borroughs, Walter	E.E.	*Chicago, Ill.*	9730 Winston Ave.
Bready, William M.	M.E.	*Chicago, Ill.*	4746 Princeton Ave.
Bromberg, Nathan	C.E.	*Chicago, Ill.*	1330 Washburne Ave.
Bunge, Ludwig W. A.	M.E.	*Chicago, Ill.*	225 S. Homan Ave.
Bush, Ernest H.	F.P.E.	*Joliet, Ill.*	
Chamberlin, Joseph F.	F.P.E.	*Chicago, Ill.*	519 N. Central Ave.
Chase, D. A.	C.E.	*Sioux City, Iowa*	3324 Dearborn St.
Chaund, William H.	C.E.	*Canton, China*	3857 Cottage Grove Ave.
Chipman, F. L.	M.E.	*Anamosa, Iowa*	665 Barry Ave.
Close, Lyman W.	M.E.	*Chicago, Ill.*	474 E. 41st St.,
Congdon, Charles C.	C.E.	*Bristol, Ind.*	Riverside, Ill.
Conklin, Joseph T.	E.E.	*Chicago, Ill.*	6824 Lafayette Ave.
Cooban, Frank G.	M.E.	*Chicago, Ill.*	518 W. 62nd St.
Cruttenden, Charles N.	A.	*Northfield, Minn.*	3329 Armour Ave.
Curtis, Robert C.	C.E.	*Chicago, Ill.*	5539 Monroe Ave.
Dempster, Charles	M.E.	*Chicago, Ill.*	6215 Lexington Ave.
Diebold, Paul	M.E.	*West Chicago, Ill.*	
Diemecke, Curt W. C.	Ch.E.	*Chicago, Ill.*	3520 N. Hamilton Ave.
Dodge, Adiel Y.	M.E.	*Chicago, Ill.*	Lakota Hotel.
Downey, L. S.	M.E.	*Chicago, Ill.*	6628 Lafayette Ave.
Dubinsky, Abraham	E.E.	*Kieff, Russia*	1311 N. Robey St.
Duffy, Joseph L.	C.E.	*Chicago, Ill.*	1907 Warren Ave.
Eales, James F.	E.E.	*Richmond, Ky.*	3741 Indiana Ave.
Evers, Arthur J.	M.E.	*Chicago, Ill.*	4335 Wabash Ave.
Farrier, Clarence W.	A.	*Tipton, Iowa*	806 West 78th St.
Faulkner, Fred L.	M.E.	*Aurora, Mo.*	48 West 34th St.
Fitterman, Noe	C.E.	*Paris, France*	6917 Normal Blvd.
Fossler, Dean L.	E.E.	*Leaf River, Ill.*	3214 Michigan Ave.
Freeman, Breo A.	A.	*Chicago, Ill.*	3404 Prairie Ave.
Galloway, Robert B.	E.E.	*Chicago, Ill.*	5513 Drexel Ave.
Gedge, Frederick C., Jr.	M.E.	*Waukegan, Ill.*	
Geiger, Carl E., Jr.	Ch.E.	*Louisville, Ky.*	3318 Dearborn St.
Ghasiguian, M. V.	E.E.	*Constantinople, Turkey*	2839 West 25th St.
Gibson, Bayard K.	A.	*Chicago, Ill.*	6409 Emerald Ave.
Gilbert, W. J.	E.E.	*El Paso, Tex.*	3334 Dearborn St.
Gillidette, Walter L.	C.E.	*Chillicothe, Mo.*	5320 Calumet Ave.
Giryotas, Walter J.	Ch.E.	*Chicago, Ill.*	726 26th St.
Goe, David M.	M.E.	*Chicago, Ill.*	514 E. 36th St.
Gothwaite, Everett D.	Ch.E.	*Chicago, Ill.*	5751 Madison Ave.
Graves, Bernard S.	A.	*Hammond, Ind.*	
Griffith, Archie B.	A.	*Omaha, Neb.*	3328 Indiana Ave.
Grodsky, M.	C.E.	*Chicago, Ill.*	1321 N. Irving Ave.
Gross, Will F.	C.E.	*Oklahoma, Okla.*	6152 Ellis Ave.
Grossman, Al. N.	Ch.E.	*Chicago, Ill.*	1439 N. Rockwell St.
Hailey, James G.	E.E.	*Corsicana, Tex.*	6020 Langley Ave.
Hamilton, Chester F.	A.	*Chicago, Ill.*	6216 Kimbark Ave.

Freshman Class—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Hannaford, George A.	E.E.	*Chicago, Ill.*	3518 S. Robey St.
Hanson, Chester	M.E.	*Chicago, Ill.*	4069 Evanston Ave.
Heinrich, Walter A.	E.E.	*Oklahoma, Okla.*	6152 Ellis Ave.
Hennessey, William H.	C.E.	*LaPorte, Ind.*	65 Schiller St.
Hirose, Yoshisakn	A.	*Nagasaki, Japan.*	3200 Calumet Ave.
Hirschfeld, Leo S.	A.	*Chicago, Ill.*	2133 Crystal St.
Hockenberger, Philip R.	M.E.	*Columbus, Neb.*	3142 Michigan Ave.
Holtman, Irving	A.	*Chicago, Ill.*	4243 Langley Ave.
Houle, Dudley L.	M.E.	*Sturgeon Bay, Wis.*	4526 Vincennes Ave.
Isensee, F. M.	A.	*Edwardsville, Ill.*	1501 E. 64th St.
Johnson, Ernest B.	A.	*Chicago, Ill.*	917 Airdrie Place.
Juttemeyer, Walter L.	M.E.	*Alton, Ill.*	3312 Dearborn St.
Kadinsky, Max	C.E.	*Chicago, Ill.*	1309 N. Leavitt St.
Kang, Wai	M.E.	*Canton, China*	57 Randolph St.
Kiene, Theodore J.	C.E.	*Omaha, Neb*	3312 Dearborn St.
Klein, Frank	E.E.	*Chicago, Ill.*	4332 Indiana Ave.
Klein, Val S.	M.E.	*Papillion, Neb.*	3312 Dearborn St.
Kleinman, George W.	Ch.E.	*Chicago, Ill.*	114th St. and Muskegon Ave.
Knuepfer, C. A.	C.E.	*Chicago, Ill.*	3432 Janssen Ave.
Koffman, Lewis	A.	*Chicago, Ill.*	1120 Hermitage Ave.
Kratz, Edward M.	F.P.E.	*Chicago, Ill.*	626 Groveland Park.
Krogman, Herbert	A.	*Oak Park, Ill.*	
Lampe, Clarence W.	A.	*Chicago, Ill.*	4138 N. Syracuse Ave.
Lauletta, Joseph, Jr.	Ch.E.	*Chicago, Ill.*	671 Milwaukee Ave.
Levenfeld, William	C.E.	*Chicago, Ill.*	1241 S. Sangamon St.
Lewis, Jacob	A.	*Chicago, Ill.*	3519 Wabash Ave.
Lewison, Arthur	C.E.	*Chicago, Ill.*	4241 Calumet Ave.
Lister, Everett	E.E.	*Chicago, Ill.*	3006 Logan Blvd.
Lord, Harry H.	E.E.	*Morris, Minn.*	4521 Lyman Ave.
Luder, Earl E.	E.E.	*Baraboo, Wis.*	3142 Michigan Ave.
Lurvey, Louis	A.	*Chicago, Ill.*	1230 Blue Island Ave.
Lyons, Raymond J.	M.E.	*Chicago, Ill.*	6036 Lafayette Ave.
McClellan, Prince	E.E.	*Corsicana, Tex.*	3414 Indiana Ave.
McCray, Harold E.	M.E.	*Augusta, Kan.*	1513 East 54th Place.
McKeage, John A.	Ch.E.	*Morris, Ill.*	6043 Woodlawn Ave.
Madden, James W.	A.	*Chicago, Ill.*	5711 Wabash Ave.
Mammes, Harry A.	E.E.	*Springfield, Ohio.*	4139 Indiana Ave.
Manson, Louis D.	E.E.	*Nashville, Tenn.*	1161 N. State St.
Markham, Earl B.	F.P.E.	*Tahlequah, Okla.*	3416 Calumet Ave.
Markham, Hogan	Ch.E.	*Tahlequah, Okla.*	3416 Calumet Ave.
Marx, Emmet	C.E.	*Chicago, Ill.*	3247 Groveland Ave.
Marx, Victor E.	Ch.E.	*Chicago, Ill.*	959 Webster Ave.
Mayer, James Leo	M.E.	*Chicago, Ill.*	251 W. 61st Place.
Mieczkowski, T.	E.E.	*Chicago, Ill.*	3351 Indiana Ave.
Nagle, John L.	C.E.	*Chicago Hts., Ill.*	
Nebel, Herman C.	M.E.	*Chicago, Ill.*	2618 Fifth Ave.
Osmer, Lawrence E.	A.	*Boone, Iowa*	3930 Dakin St.
Owen, Russell	C.E.	*Chicago, Ill.*	152 N. Walnut Ave.
Palmer, Roger C.	M.E.	*Chicago, Ill.*	6325 Morgan St.
Paradis, Emile E.	C.E.	*Chicago, Ill.*	6419 Champlain Ave.

FRESHMAN CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Parratt, Norris E.	A.	*Highland Pk., Ill.*	
Parrott, Raymond D.	Ch.E.	*West Chicago, Ill.*	
Pathofsky, Felix	C.E.	*Radomysl, Russia.*	1319 Elburn Ave.
Patterson, Cecil E.	M.E.	*St. Narys, Ont.*	3416 Calumet Ave.
Peterson, Arthur L.	C.E.	*Chicago, Ill.*	1424 E. 70th St.
Peterson, Thorwald.	A.	*Chicago, Ill.*	5909 Ontario St.
Pfafflin, Theodore K.	E.E.	*Chicago, Ill.*	7140 Eggleston Ave.
Pfaelzer, Jerome L.	F.P.E.	*Chicago, Ill.*	4926 Washington Pk Pl.
Pfeifer, Walter S.	E.E.	*Sheboygan Falls, Wis.*	2426 Indiana Ave.
Phillips, Charles T.	M.E.	*Birmingham, Ala.*	3336 Michigan Ave.
Porter, Earl W.	A.	*Atlantic, Iowa.*	5320 Calumet Ave.
dePoyen, Rene.	Ch.E.	*Chicago, Ill.*	725 E. 42nd St.
Prest, Irving.	Ch.E.	*Chicago, Ill.*	4344 N. Oakley Ave.
Rehnquist, Alf. C.	M.E.	*Chicago, Ill.*	7417 Luella Ave.
Rehnquist, Paul A.	M.E.	*Chicago, Ill.*	218 West 113th St.
Renaud, Eugene.	E.E.	*Chicago, Ill.*	5246 Calumet Ave.
Rietz, Walter H.	F.P.E.	*Chicago, Ill.*	560 Hawthorne Place.
Riheldoffer, William A.	E.E.	*Charleston, W. Va.*	4915 Washington Ave.
Rissman, Maurice B.	A.	*Chicago, Ill.*	2637 Potomac Ave.
Roethe, P. H.	M.E.	*Chicago, Ill.*	5545 Drexel Ave.
Rook, Henry A.	C.E.	*Chicago, Ill.*	7126 Lowe Ave.
Roy, Herman C.	A.	*Chicago, Ill.*	2852 East 91st St.
Sanborn, William L.	M.E.	*Moville, Iowa.*	
Schiffers, Emil A.	A.	*San Antonio, Tex.*	3437 Michigan Ave.
Schreiber, Ernest F.	A.	*Hammond, Ind.*	
Schuette, Otto T.	Ch.E.	*Chicago, Ill.*	3950 N. Ashland Ave.
Schulze, Charles P.	A.	*San Antonio, Tex.*	48 W. 34th St.
Seeberger, Harry F.	E.E.	*Chicago, Ill.*	4226 Calumet Ave.
Seeglitz, Albert H.	M.E.	*Chicago, Ill.*	170 North Ave.
Severin, Enoch N.	C.E.	*Chicago, Ill.*	833 E. 47th St.
Shaffer, Lawrence B.	E.E.	*Pawnee, Okla.*	3000 Michigan Ave.
Shaffer, Sydney.	E.E.	*Chicago, Ill.*	5330 Calumet Ave.
Shakman, James.	Ch.E.	*Chicago, Ill.*	220 E. 46th St.
Sherwood, Herbert P.	M.E.	*Chicago, Ill.*	6452 Minerva Ave.
Sieck, Ernst.	Ch.E.	*Chicago, Ill.*	619 Deming Place.
Sieh, Elmer J.	A.	*Sutherland, Iowa.*	3819 Michigan Ave.
Simmons, Charles R.	C.E.	*Chicago, Ill.*	4440 N. Lincoln St.
Skidmore, J. Robert.	E.E.	*Chillicothe, Mo.*	3414 Calumet Ave.
Sloan, Lewis W.	E.E.	*Hamilton, Mo.*	23 W. 31st St.
Smith, T. Barrett.	A.	*Chicago, Ill.*	618 E. 50th Place.
Smith, William J.	C.E.	*Chicago, Ill.*	3819 Rhodes Ave.
Sockman, Arthur.	C.E.	*Chicago, Ill.*	4727 Indiana Ave.
Spitz, Martin.	M.E.	*Chicago, Ill.*	4331 Calumet Ave.
Springer, Ormond S.	E.E.	*Chicago, Ill.*	7540 Lake Ave.
Sproesser, George.	C.E.	*Sioux Falls, S. D.*	37 W. 33rd St.
Stark, Andrew G.	A.	*Lang, Ontario.*	6733 Lafayette Ave.
Steinhart, Clarence E.	M.E.	*Wilmington, Ill.*	
Stepanek, Emil.	M.E.	*Chicago, Ill.*	2448 S. Millard Ave.
Strain, Harry H.	Ch.E.	*Joliet, Ill.*	4206 Lake Ave.
Stromback, Ernest J.	C.E.	*Lindstrom, Minn.*	Division St. Y. M. C. A.
Suffern, William E.	C.E.	*Joliet, Ill.*	48 W. 34th St.

FRESHMAN CLASS—*Continued.*

NAME.	COURSE.	HOME.	PRESENT CHICAGO ADDRESS.
Sullivan, Elliott M	C.E.	*Chicago, Ill.*	4709 Michigan Ave.
Sullivan, Thomas	E.E.	*Chicago, Ill.*	6116 Rhodes Ave.
Thal, Sam	M.E.	*Chicago, Ill.*	5333 Calumet Ave.
Trinkaus, George J	C.E.	*Chicago, Ill.*	708 N. May St.
Tulien, Ture	M.E.	*Topeka, Kan.*	3350 Union Ave.
Wagner, Fred H	A.	*San Antonio, Tex.*	3437 Michigan Ave.
Ward, Fred L	M.E.	*Chicago, Ill.*	905 Lafayette Parkway.
Webb, James	M.E.	*Thornton, Ill.*	
Wight, Clifford D	M.E.	*Trinidad, Colo.*	6209 Lexington Ave.
Wilson, Robert L	Ch.E.	*Chicago, Ill.*	7046 Normal Ave.
Windsor, John J	A.	*Santa Fe, N. M.*	3120 Indiana Ave.
Wolfson, William	E.E.	*Chicago, Ill.*	5118 Michigan Ave.
Wood, Douglas	C.E.	*Chicago, Ill.*	818 Bowen Ave.
Wright, C. F	E.E.	*Waterloo, Iowa*	3338 Armour Ave.
Yamamoto, I	Ch.E.	*Nakayama, Japan.*	5426 Indiana Ave.
Zaldokos, Mathew E	A.	*Kovno, Russia*	3332 Dearborn St.

SPECIAL STUDENTS.

NAME.	HOME.	PRESENT CHICAGO ADDRESS.
Block, David J	*Chicago, Ill.*	1456 Plum St.
Gugis, Kasimir	*Lithuania, Russia*	118 The Mecca Bldg.
Harrell, Miss E. O	*Chicago, Ill.*	4931 Indiana Ave.
Jenson, John R	*Tarkio, Mo.*	5624 Ellis Ave.
Mark, Perry C	*Zanesville, Ohio*	3214 Michigan Ave.
Patton, Fred W	*Waupun, Wis.*	3640 Cottage Grove Ave.
Stebbins, Don M	*Davenport, Iowa*	5824 Woodlawn Ave.
Wallace, Fred	*Alsajava, Hungary*	Highland Park, Ill.
Young, John Law	*Canton, China*	349 S. Clark St.

STATISTICS.

SUMMARY OF ATTENDANCE FOR THE YEAR 1911-1912.

Seniors	89	Mechanical Engineering	107
Juniors	111	Electrical Engineering	125
Sophomores	174	Civil Engineering	146
Freshmen	179	Chemical Engineering	61
Special Students	9	Fire Protection Engin'g	15
		Architecture	98
College Students, total	562	Industrial Arts	1
		Special Students	9
		College Students, total	562

Students in the College of Engineering	562
Students in the Evening Classes	644
Students in the Summer Courses	230
Students in the Armour Inst. of Tech., total	1,436
Deduct names counted twice	156
Final total	1,280

ATTENDANCE IN THE COLLEGE OF ENGINEERING, SHOWING STATES AND FOREIGN COUNTRIES REPRESENTED.

Alabama	1
Arkansas	3
Colorado	3
Florida	1
Illinois (342 are from the City of Chicago)	397
Indiana	10
Iowa	21
Kansas	6
Kentucky	5
Louisiana	2
Michigan	6
Minnesota	6
Mississippi	1
Missouri	6
Montana	2
Nebraska	14
New Mexico	1
New York	2
Ohio	4
Oklahoma	5
Oregon	1
South Dakota	3
Tennessee	2
Texas	10
Washington	1
West Virginia	1
Wisconsin	18
Wyoming	2

Twenty-eight states represented by 534 students.

Canada	3
China	4
Cuba	1
France	1
Germany	1
Hungary	1
Japan	5
New Zealand	1
Russia	5
South Africa	1
South America	1
Sweden	2
Turkey	1
West Indies	1

Fourteen foreign countries represented by 28 students.

Total	562

ALUMNI ASSOCIATIONS.

The *Chicago Alumni Association* of Armour Institute of Technology holds two annual meetings in Chicago, one in December and one in June. It includes in its membership all graduates of the College of Engineering. The President and the Deans are honorary members of the Association. Associate membership is open to non-graduates having pursued a course during two years as members of classes that have graduated.

Officers for 1911-1912:
President, F. M. de Beers, '05.
Vice-President, R. B. Harris, '02.
Treasurer, Harold S. Ellington, '08.
Recording Secretary, W. H. Beattys, '99.
Corresponding Secretary, J. C. Penn, '05.
Master of Ceremonies, Donald MacKenzie, '98.

The *Pennsylvania Alumni Association* of Armour Institute of Technology was organized in 1904 at Pittsburg, Pa. It holds two annual meetings, one in May and the other at some convenient time near the close of the year.

REGISTER OF GRADUATES*

FROM THE

COLLEGE OF ENGINEERING.

The following abbreviations are used to denote the department in which the graduate received the degree of B. S.:

I.—Civil Engineering.
II.—Mechanical Engineering.
III.—Electrical Engineering.
IV.—Chemical Engineering.
V.—Architecture.
VI.—Fire Protection Engineering.

NAME AND OCCUPATION. ADDRESS.

Abell, H. C.—III '04.....New York City, N. Y.
Chief Engineer, American Light & Traction Co., New York City, N. Y.
President, Muskegon Traction & Lighting Company, Muskegon, Mich.

Adams, Edgar Whittington—III '08.. 1125 Columbia Road, N. W., Washington, D. C.
Third Ass't Examiner, United States Patent Office, Washington, D. C.

Ahern, John F.—VI '09.....Wayne, Nebraska.
Ass't Engineer, Underwriters' Laboratories, 207 East Ohio St., Chicago, Ill.

Allen, Orrin Thomas—I '06.....649 E. 47th St., Chicago, Ill.
American Steel & Wire Co., Commercial National Bank Bldg., Chicago, Ill.

Alling, Claude R.—VI '07.....1315 Elmwood Ave., Evanston, Ill.
Ass't Engineer, Underwriters Laboratories, 207 East Ohio St., Chicago, Ill.

Alling, Harold M.—VI '11.....124 S. Oxford St., Brooklyn, N. Y.
Inspector, Underwriters' Bureau, Middle and Southern States, 68 Williams St., New York City.

Allyn, Arthur Joseph—III '06.....343 Oakwood Blvd., Chicago, Ill.
Engineer, Kohler Brothers, Fisher Bldg., Chicago, Ill.

Alschuler, Alfred S.—V '99, M. S. '04.3945 Ellis Ave., Chicago, Ill.
Architect, 1900 Steger Bldg., Chicago, Ill.

Ambrose, Roy Barton—II '11.....Pittsburg, Pa.
Ass't Instructor, Engineering Laboratory, Carnegie Technical Schools, Pittsburg, Pa.

Anderson, A. G.—I '10.....6636 Normal Ave., Chicago, Ill.

Anderson, Arthur Henry—II '02,
M. E. '06.....4191 Wayne Ave., Rogers Park, Ill.
Ass't Prof. of Experimental Engineering, Armour Institute of Technology, Chicago.

Anderson, H. C.—I '09.....3142 Michigan Ave., Chicago, Ill.
American Bridge Company, Detroit, Mich.

Anderson, Leonard C.—III '11.....Sioux City, Iowa.
Instructor of Mechanical Drawing, Sioux City High School, Sioux City, Iowa.

Anderson, Marion Julian—III '08...Hartford, Mich.
Superintendent, Municipal Lighting Plant, Hartford, Mich.

Andrews, Ellis Erastus—IV '08.....1381 John R. St., Detroit, Mich.
Chemist, 1145 Washtenaw Ave., Ann Arbor, Mich.

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*Graduates of Armour Institute of Technology are earnestly requested to forward to the Institute copies of their *publications* and particulars of any *patents* issued, for preservation in the Library of the Institute.
The Institute Bulletin is issued yearly in May. Changes of addresses and occupations should be reported to the Office of the Deans promptly and not later than April 1st in order to insure correct insertions.

NAME AND OCCUPATION. ADDRESS.

Armstrong, Julius Roy—III '05,
E. E. '09.....204 Cheyenne Rd., Colorado Springs, Colo.
Consulting Electrical Engineer, 303 Colo. Bldg., Colorado Springs, Colo.

Arnold, Mark H.—III '01.....Toronto, Kansas.

Ash, Howard Joseph—III '05.....6040 Jefferson Ave., Chicago, Ill.
Construction Department, Commonwealth Edison Company, 139 Adams St., Chicago, Ill.

Austin, Lulu Clarissa—V '02.....Williamson, N. Y.

Axen, Charles A. V.—II '01,
M. E. '05.....Baraboo, Wis.
Master Mechanic, Chicago & Northwestern Railway, Madison Division, Baraboo, Wis.

Babcock, Fred Ripley—III '03,
E. E. '08.....5546 Madison Ave., Chicago. Ill.
Proprietor, Electrical Power Equipment Co., 1551 Marquette Bldg., Chicago, Ill.

Badger, Harold Ralph—III '08.....26 Commonwealth Ave., Detroit, Mich.
Assistant Manager of Sales, The Hoskins Manufacturing Company, Detroit, Mich.

Badger, Leroy H.—I '07.....Niles, Mich.
Civil Engineer, Philippine Islands' Service, United States Government, Manila, P. I.

Baer, Walter J.—III '10.....3317 South Park Ave., Chicago, Ill.
With L. L. Summers & Co., 164 Dearborn St., Chicago, Ill.

Bailey, Clarence C.—III '10.....3142 Michigan Ave., Chicago, Ill.
Signal Department, Illinois Central R. R., Chicago, Ill.

Baird, Manley Frank—III '02.....Wayside, Nebraska.
County and U. S. Surveyor, Davies County, Wayside, Nebraska.

Baker, Charles—III '06, E. E. '10....6949 South Park Ave., Chicago, Ill.
With W. E. Barnard & Son, Building Contractors, 826 Opera House Bldg., 112 Clark St., Chicago, Ill.

Baker, Earl Head—II '01.....721 Warren St., Evanston, Ill.
Supt. Machine Shops, National Biscuit Company, Evanston, Ill.

Banning, Thomas A.—III '07.....5535 Monroe Ave., Chicago, Ill.
Solicitor of Patents, 1632 Marquette Bldg., Chicago, Ill.

Banta, John Sidney—II '03,
M. E. '07.....1142 North Ave., Waukegan, Ill.
Chief Draftsman, American Steel & Wire Company, Waukegan, Ill.

Barrett, Dwight Orion—II '08.....353 12th St., Brandon, Man., Canada.
Superintendent Manitoba Windmill and Pump Co., Brandon, Man., Canada.

Battey, Frederick Valentine—III '03. Deceased.

Baughman, I. N.—II '10.....Marseilles, Ill.

Beamer, Burton Evans—III '05.....605 Elm St., Anaconda, Mont.
Ass't Chief Electrician, Anaconda Copper Mining Co., Anaconda, Mont.

Beattys, William Henry—III '99....Western Springs, Ill.
Western District Manager, National Brake & Electric Co., First National Bank Bldg., Chicago, Ill.

Beaty, Eugene Mark—III '08.....Powder River, Wyo.
Superintendent Beaty Contracting Company, Powder River, Wyo.

Beaudry, Ralph L.—V '11.....7047 Princeton Ave., Chicago, Ill.
With the Allison Construction Co., Chicago, Ill.

NAME AND OCCUPATION. ADDRESS.

Beck, C. E.—II '11.....4855 Winthrop Ave., Chicago, Ill.
Sales Engineer, De La Vergne Machine Co., 1504 Fisher Bldg., Chicago, Ill.

Beckman, Herman E.—I '09.....77 Jefferson Ave., Naperville, Ill.
Civil Engineer, Bridge and Building Dept., Chicago, Milwaukee & St. Paul Railway, 1232 Railway Exchange Bldg., Chicago, Ill.

de Beers, Franklin Martin—IV '05,
Chem. Eng. '10.....4501 Woodlawn Ave., Chicago, Ill.
President and General Manager, Swenson Evaporator Company, 945 Monadnock Block, Chicago, Ill.

Benedict, Allen Boyer—III '04.....
E. E. '09.....132 East 50th St., Chicago, Ill.
Chief Draftsman, Goodman Manufacturing Co., Chicago, Ill.

Bergbom, Arthur L.—II '10.....2643 N. Talman Ave., Chicago, Ill.
With the Under-Feed Stoker Co., 1807 Harris Trust Bldg., Chicago, Ill.

Bernhard, Frank Hugo—III '01,
E. E. '07.....3220 Fulton St., Chicago, Ill.
Associate Editor, Electrical Review and Western Electrician, 507 Marquette Bldg., Chicago, Ill.

Bexten, Louis Noyes—III '09.....1008 Oakwood Ave., Wilmette, Ill.
Clark Street Station, North Shore Electric Co., Evanston, Ill.

Binder, Charles William—I '11.....5428 Monroe Ave., Chicago, Ill.
With the Leonard Construction Co., 1937 McCormick Bldg., Chicago, Ill.

Binder, Guerdon A.—III '09.....Earlville, Ill.

Bippus, Sumner Ellis—III '99.....Deceased.

Blodgett, Edgar E.—III '98.....1112 East 58th St., Chicago, Ill.
Special Agent, North British & Mercantile Co., 159 La Salle St., Chicago, Ill.

Blumenthal, Edward A.—III '07....1903 Mohawk St., Chicago, Ill.
Consulting Engineer, Chicago, Ill.

Boblett, K. M.—'09.....626 Nessle St., Toledo, Ohio.
Radiator Expert, The Kinsey Manufacturing Co., Toledo, Ohio.

Boehmer, Alexander H.—II '07.....3128 Lexington St., Chicago, Ill.

Bolté, Edward E.—II '10.....3757 Ellis Ave., Chicago, Ill.
Assistant Chemist, Peoples Gas Light and Coke Co., Chicago, Ill.

Bornstein, Hymen—IV '11.....1217 East 47th St., Chicago, Ill.
Chemist, Commercial Testing & Engineering Co., Chicago, Ill.

Borst, George William—III '04.....622 Laurel Ave., Chicago, Ill.
Electrical Engineer, Power Telephone Engineering Department, Western Electric Company, Hawthorne Station, Chicago, Ill.

Botteron, Clarence Irvin—V '08.....Chicago, Ill.
With Messrs. Lebenbaum & Marx, Chicago Savings Bank Bldg., Chicago, Ill.

Boughton, Newell J.—II '09.....Topeka, Kansas.
Engine Inspector of Atchison, Topeka & Santa Fe Railroad, Topeka, Kansas.

Bowman, D. W.—V '10.....Kearney, Mo.

Brackett, John Charles—III '05.....Copper Hill, Tenn.
Ass't Engineer, Tennessee Copper Co., Copper Hill, Tenn.

Bradford, Percival L.—III '11.....Schenectady, N. Y.
Testing Engineer, General Electric Co., Schenectady, N. Y.

Bradley, Lyford C.—II '00, M.E. '05.1144 National Ave., Milwaukee, Wis.
Master Mechanic, International Harvester Co., Milwaukee, Wis.

NAME AND OCCUPATION. ADDRESS.

Brashares, Harry Ernest—III '05,
E. E. '08.....1853 Laurel Ave., Chicago, Ill.
With the Great Northern R. R. Co., St. Paul, Minn.

Bredlau, Albert Ernest—I '11.....2301 S. 43rd Court, Chicago, Ill.
Draftsman, City Hall, Chicago, Ill.

Bremers, Henry J., Jr.—III '10.....East Fifth St., Fremont, Neb.

Briggs, Marion Wallace—III '02....Dowagiac, Mich.
General Manager, Cass County Home Telephone Co., Dowagiac, Mich.

Brimson, Charles Tamlin—I '03,
C. E. '08.....328 Sheidly Blvd., Kansas City, Mo.
Engineer, Maintenance of Way, Iowa & St. Louis Railway Co., Kansas City, Mo.

Brock, Walter Laurence—II '06.....132 W. 64th St., New York City, N. Y.
Engineer with A. W. Herring, New York City, N. Y.

Brubaker, William C.—II '06,
M. E. '11.....6542 Ellis Ave., Chicago, Ill.
Foreman, Template Department, The Pullman Car Co., Pullman, Ill.

Buckett, Arthur C.—V '09.....

Buehler, Martin Anton—III '08.....5014 Izard St., Omaha, Neb.
Western Sales Agent, Fort Wayne Electric Works, Omaha, Neb.

Buie, Arthur—III '04.....433 West 60th St., Chicago, Ill.

Burge, George Cummings—II '08....321 Fourth St., Wilmette, Ill.
Chief Draftsman, The Arnold Co., Chicago, Ill.

Burkholder, Fred L.—I '07.....711 College Ave., Pittsburg, Pa.
Ass't Engineer of Erection, Riter-Conley Mfg. Co., Pittsburg, Pa.

Burr, Arthur James—III '99.....2856 Russell Ave., St. Louis, Mo.
Director of Mechanical Drawing Dept., McKinley High School, St. Louis, Mo.

Busse, Clayton Francis—II '08.....3506 Bosworth Ave., Chicago, Ill.
Sales Agent, The Hoskins Manufacturing Co., 321 Dearborn St., Chicago, Ill.

Butler, Horace Lund—I '11.....Libertyville, Ill.
Civil Engineer, Chicago & N. W. R. R. Co., Sioux City, Iowa.

Byers, A. A.—II '10.....7231 Union Ave., Chicago, Ill.
Mechanical Engineer, Union Stockyard & Transit Co., Chicago, Ill.

Byrne, Louis James—II '04.....6544 Lafayette Ave., Chicago, Ill.
Insurance Survey Bureau, 159 La Salle St., Chicago, Ill.

Byrne, W. M.—II '03.....Philadelphia, Pa.

Cahan, James—I '08.....1217 N. Hoyne Ave., Chicago, Ill.
With Jos. T. Ryerson, Chicago, Ill.

Campbell, E. E.—III '07.....3428 Indiana Ave., Chicago, Ill.
Distribution Engineer, Commonwealth Edison Co., 84 Market St., Chicago, Ill.

Campbell, Mrs. M. W.—I '00.....Location unknown.

Carlson, Henry William—II '10.....Central Y. M. C. A., Montreal, Can.
Manager, the Roebling Construction Co., 204 Merchants Bank Building, Montreal, Canada.

Carr, Alva Lee—II '06.....6356 South Green St., Chicago, Ill.
Secretary and Treasurer, The Carr Bros. Wrecking Company, 3039 South Halsted St., Chicago, Ill.

Carroll, Emil Joseph—III '05, E.E. '10.4154 Ellis Ave., Chicago, Ill.
Sprague Electric Company, 516 Fisher Bldg., Chicago, Ill.

NAME AND OCCUPATION. ADDRESS.

Cerny, James—I '08.....2430 S. Lawndale Ave., Chicago, Ill.
With the American System of Reinforcing, Otis Bldg., Chicago, Ill.

Chamberlin, Earl W.—I '09.....5443 South Halsted St., Chicago, Ill.
Designer, The Rodgers Co., Monadnock Bldg., Chicago, Ill.

Chan, Yoke H.—II '11.....100 East Randolph St., Chicago, Ill.

Chapman, Alfred B., Jr.—III '10....5031 Kenmore Ave., Chicago, Ill.

Chapman, Paul Reed—III '97.....1112 North Clark St., Chicago, Ill.
With the Chicago Telephone Co., Chicago, Ill.

Charles, Walter Thomas—IV '02....448 Elm St., Chicago, Ill.

Chatain, Paul E.—IV '09.....4538 Lake Ave., Chicago, Ill.

Church, Edwin Sears—III '97,
M. E. '03.....315 East Market St., Akron, Ohio.
Superintendent, Akron Works, International Harvester Co., Akron, Ohio.

Clark, Frank Cordley—III '05.....Wheeling, W. Va.
Ass't Engineer, Department of Construction and Engineering, Culebra, Canal Zone, R. P.

Clarke, Fred—III '07.....Detroit, Mich.
Division Traffic Supervisor, Michigan State Telephone Company, Detroit, Michigan.

Clarkson, William, Jr.—I '10.....3437 Prairie Ave., Chicago, Ill.
With the American Sheet and Tin Plate Co., Gary, Ind.

Clausen, Henry W.—I '04, C. E. '08.4465 Woodlawn Ave., Chicago, Ill.
Ass't City Engineer in charge of Pumping Stations and Tunnels, 325 City Hall, Chicago, Ill.

Cleaver, Thane Griffith—I '11.....4109 Kenmore Ave., Chicago, Ill.

Clucas, George Worden—II '06.....6906 Perry St., Chicago, Ill.
Engineer and Salesman, American Steam Pump Company, 310 W. Randolph St., Chicago, Ill.

Cohen, Louis—III '01.....Brant Rock, Mass.
Chief Engineer, Research Dep't., National Electric Signaling Co., Brant Rock, Mass.

Cole, Victor E.—I '10.....215 Dearborn St., Chicago, Ill.
With Hawes & Dodd, Tiles, Ceramic Mosaics & Fireplace Furnishings, 59 E. Adams St., Chicago, Ill.

Collins, Frank Campbell—III '08....739 Farragut Ave., Chicago, Ill.
Sales Agent, General Electric Co., Minneapolis, Minn.

Collins, Frederick L.—III '04.....746 East 70th St., Chicago, Ill.
Electrical Foreman, Universal Portland Cement Company, Buffington, Ind.

Collins, Ward Olive—IV '02.....Chicago, Ill.
Chemical Engineer, Gulick-Henderson & Co., Manhattan Bldg., Chicago, Ill.

Collins, William Randall—IV '06...904 Wilson Ave., Chicago, Ill.
Salesman, New York & Ohio Co., 701 West Jackson Blvd., Chicago, Ill.

Conlin, William Francis—II '09.....Donora, Pa.
With the Am. Steel & Wire Co., Donora, Pa.

Converse, William Irving—I '08.....Caruthersville, Mo.
Superintendent of the Deering Southwestern R. R., Caruthersville, Mo.

Cook, Norman Wolcott—V '06.....539 E. 62nd St., Chicago, Ill.
Draftsman, Marshall & Fox, Architects, First Nat. Bank Bldg., Chicago, Ill.

Copenhaver, Harold K.—I '07.....6437 Harvard Ave., Chicago, Ill.
Civil Engineer, Sewer Department, City Hall, Chicago, Ill.

NAME AND OCCUPATION. ADDRESS.

Corey, Sidney Thomas—III '99.....10444 Seeley Ave., Chicago, Ill.
Chief Draftsman, Bridge Dept., Chicago, Rock Island & Pacific Railroad, La Salle St. Station, Chicago, Ill.

Cornwell, Augustus Booker—III '08..1209 W. Fifth Ave., Spokane, Wash.
Engineer, Washington Water Power Co., Spokane, Wash.

Coy, Frank Albert—I '04.....Corinth, Miss.
Instrumentman, Illinois Central Railway, Corinth, Miss.

Crane, Edwin B.—III '09.....505 42d Place, Chicago, Ill.
Assistant Engineer, Michigan United Railways Co., Jackson, Mich.

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Kaiser, Everett D.—III '11.....Rochester, N. Y.
Assistant Factory Superintendent, 176 Anderson Ave., Rochester, N. Y.

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With the Metropolitan Elevated R. R. Co., Chicago, Ill.

Kappes, Edward F.—III '98.....310 Park Ave., Chicago, Ill.
Engineer, Chicago Telephone Company, 203 Washington St., Chicago, Ill.

Keeth, Grover—II '06, M.E. '10....7105 Princeton Ave., Chicago, Ill.
Chief Engineer, North Shore Electric Co., Blue Island, Ill.

Kellner, Otto R.—I '11.....2142 Sedgwick St., Chicago, Ill.

Kellner, W. A.—I '10.....714 Buckingham Place, Chicago, Ill.
Designer, Mead, Morrison & Co., Chicago, Ill.

Kilgore, Clarence Earle—II '07.....Hood View Ranch, Springwater, Ore.

Kimball, Raymond Watson—II '06..37 E. Garfield Blvd., Chicago, Ill.
Assistant Boiler Room Engineer, Fisk St. Station, Commonwealth Edison Co., Chicago, Ill.

Klapper, Charles—III '06.....359 E. 53rd St., Chicago, Ill.
Engineer, Mount Hood Ry. & Power Co., Portland, Oregon.

Klein, Samuel—I '06, C. E. '09.....3054 West North Ave., Chicago, Ill.
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With the Pere Marquette R. R. Co., Benton Harbor, Mich.

Knapp, Morris Jason—III '04.....Chicago, Ill.
Ass't Electrical Engineer, 92 West Van Buren Street, Chicago, Ill.

Konicek, Frank, Jr.—III '11.....Lockport, Ill.
Physical and Electrical Inspection, Western Electric Co., Hawthorne, Ill.

Krum, Howard Lewis—III '06,
E. E. '11.....5135 Hibbard Ave., Chicago, Ill.
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Kuehne, J. H.—III '11.....Gowanda, N. Y.
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M. E. '11.....Butte, Mont.
Ass't Gen'l Mgr., Bamar Copper Company, 411 State Savings Bank Bldg., Butte, Mont.

Letterman, G. D.—I '10.....3342 Dearborn St., Chicago, Ill.
Civil Engineer, with the Shank Co., Stock Exchange Bldg., Chicago, Ill.

Lewis, Charles Tobias—II '99.....Honolulu, Hawaii.
Superintendent of Construction, Honolulu Constr. Co., Honolulu, Hawaii.

Lewis, Elijah—III '02.....Des Moines, Iowa.
Sales Agent, The W. K. Garton Co., 617 W. Jackson Blvd., Chicago, Ill.

Lewis, Raymond Leslie—II '08.....115 Fourth St., Waukegan, Ill.
Draftsman, American Steel & Wire Co., Waukegan, Ill.

Lewis, Walter Irving—II '01.....10212 Ostend Ave., Cleveland, Ohio.
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Lindberg, Fritz Albin—III '01,
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Livermore, Joseph D.—V '10.....158 Eugenie St., Chicago, Ill.
Draftsman, Chatten & Hammond, Steinway Hall, Chicago, Ill.

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Longnecker, Charles Sumner—II '00. .Traverse City, Mich.
Superintendent of Mills, Oval Wood Dish Co., Traverse City, Mich.

Loofbourrow, Joseph David—II '08. . .Fairfield, Iowa.

Lunak, Sidney Everett—IV '08.....Wausau, Wis.
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Lundgren, E. Leonard—I '04,
C. E. '07.....Manila, P. I.
Project Engineer, Bureau of Public Works, United States Government, Manila, P. I.

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Engineer, Arthur Frantzen Co., 569 West Van Buren St., Chicago, Ill.

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McBurney, Edward, Jr.—II '05.....944 Pine St., Oakland, Cal.
Southern Pacific Railroad Co., Motive Power & Maintenance Dept., Oakland, Cal.

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McCrackin, Wallace—III '06.....Hamilton, Mont.
Assistant Cashier, Ravalli County Bank, Hamilton, Montana.

McCune, S. W., Jr.—III '10.....Schenectady, N. Y.
Salesman, with the General Electric Co., Schenectady, N. Y.

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III '04.....552 Lyman Ave., Oak Park, Ill.
Chief Electrical Engineer, Chicago Fuse Wire & Mfg. Co., 1014 Congress St., Chicago, Ill.

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E. E. '01.....Chicago, Ill.
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Merriman, Harold A.—V '11.....Hollywood, Cal.

Merry, Earl H.—III '03.....272 Auburn Ave., Pontiac, Mich.
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Metz, Fred Wm.—VI '11.....Pewee Valley, Ky.

Meyer, Eugene Daniel—III '06.....Wichita, Kan.
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Meyer, Grover John—I '08.....Valier, Mont.
Civil Engineer, Conrad Land & Water Co., Valier, Montana.

Millard, Chauncey S.—I '07, C.E. '10.Vancouver, B. C.
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Miller, Philip F.—IV '11.....218 Irving Ave., So. Orange, N. J.
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M. E. '11.....3122 South Park Ave., Chicago, Ill.
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Morris, George E.—V '98.....314 Chicago St., Elgin, Ill.
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Morrison, Rudolph A.—III '07,
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Morrison, Ralph D.—II '06.....Harvard Chambers, Minneapolis, Minn.

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Master Car Builder, W. & L. E. R. R., East Toledo, Ohio.

Moss, Charles MacLean—III '02,
E. E. '07.....413 Lloyd Street, Pittsburg, Pa.
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Moyses, Harry E.—III '10.....Louisville, Ky.
Vice President, The Swartz Co., Louisville, Ky.

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Muñoz, Federico J.—I '10.....5613 Prairie Ave., Chicago, Ill.
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Myers, Frank Edward—III '11.....413 Lewis Ave., La Junta, Colo.
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Sales Manager, Warren, Wels & Co., Kansas City, Mo.

Nelson, C. J.—I '07.....Chicago, Ill.
Draftsman, Chicago, Milwaukee & St. Paul Railroad Co., Chicago, Ill.

Nelson, Emil Ferdinand—III '03....Goldfield, Nev.
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Neu, Matthew—V '09.....3226 93rd Street, Chicago, Ill.

Neville, W. J.—III '10.....6426 Sangamon St., Chicago, Ill.
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Noble, Alden Charles—III '01.....New York City, N. Y.
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O'Brien, Edward D.—III '97.....Seattle, Wash.
Care City Hall, Seattle, Wash.

Oberfelder, Walter—VI '09.....4619 Ellis Ave., Chicago, Ill.

Oehne, Theodore C., Jr.—III '08....5401 Ellis Ave., Chicago, Ill.
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Olsen, Elmer H.—III '99, E. E. '06..1403 Buchanan St., Amarillo, Texas.
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Paradise, Louis Albert—II '06
M. E. '11.....East Moline, Ill.
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Parker, John Henry—III '01.....Deceased.

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Patten, George H.—III '98, E. E. '10.1900 Pine St., St. Louis, Mo.
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Peters, William H.—III '09.....1801 E. 29th St., Kansas City, Mo.
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Peterson, Ivan—I '09.....1057 N. Shore Ave., Chicago, Ill.

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Petty, Edwin W.—III '09.....4134 Berkeley Ave., Chicago, Ill.
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II '02.....4910 Emerson Ave., South, Minneapolis, Minn.
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General Inspector, Phoenix Insurance Company, Cincinnati, Ohio.

NAME AND OCCUPATION. ADDRESS.

Rowe, Hugh Irwin—III '07.....518 Clinton St., Saginaw, Mich.
Superintendent of Manufacture, Saginaw City Gas Co., Saginaw, Mich.

Ruede, E. M.—III '10.....3337 Armour Ave., Chicago, Ill.
With the National X-Ray Reflector Co., Chicago, Ill.

Ruegnitz, Walter Raymond—III '01.410 S. Catherine Ave., La Grange, Ill.
Fire Protection Engineer, 431 Dearborn St., Chicago, Ill.

Sackheim, Sol—III '11.....311 S. Center Ave. Chicago, Ill.

Salamson, Max—III '97.....1362 Milwaukee Ave., Chicago, Ill.

Salisbury, Robert H.—V '10.....2425 Adams St., Chicago, Ill.
Architect, with the Board of Education. Chicago, Ill.

Salomon, Meyer Joshua—I '11.....422 W. Division St., Chicago, Ill.
Geodesist, Coast and Geodetic Survey, Chicago, Ill.

Sampson, Charles Clark—II '04.....214 Glenwood Ave., Joliet, Ill.
Chief Engineer, Illinois Steel Co., Joliet, Ill.

Sanders, Walter J.—III '07.....23 Aldine Square, Chicago, Ill.
Commonwealth Edison Company, 139 Adams Street, Chicago, Ill.

Sanford, Louis Averill—II '02.....6922 Yale Ave., Chicago, Ill.
Designer, Miehle Printing Press & Mfg. Co., Chicago, Ill.

Saunders, John Earl—III '07,
E. E. '11.....432 Buchanan St., Topeka, Kan.
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Sawtell, Henry Jacob—II '06.....Powell, Wyo.
Manager, Yellowstone Lumber Co., Powell, Wyo.

Schaedlich, Hans—III '06.....805 Belmont Ave., Chicago, Ill.
Electrical Engineer, Department of Electricity, City of Chicago, Room 402, 76 Fifth Avenue, Chicago, Ill.

Schafer, Samuel Edward—II '02,
M. E. '10.....320 Windsor Place, Milwaukee, Wis.
Engineer for the Milwaukee Mixer & Machinery Co., Milwaukee, Wis.

Scheidler, Oscar—II '02.....243 West Main St., Newark, Ohio.
Ass't Manager and Sec'y, The Scheidler Machine Works Company, First and Franklin Sts., Newark, Ohio.

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Schmidt, Emil J.—III '11.....2123 Fremont St., Chicago, Ill.
Scientific Management Investigator, The Sewell-Clapp Mfg. Co., 28 North Desplaines St., Chicago, Ill.

Schmidt, John Lorenz—VI '07.....2302 North Delaware St., Indianapolis, Ind.
Home Office Examiner, German Fire Insurance Company of Indiana, Indianapolis, Ind.

Schram, Irwin Herbert—I '08.....3426 Calumet Ave., Chicago, Ill.
Maintenance of Way Department, Erie Railroad, Chicago, Ill.

Schroeder, Carl Paul—III '99.....6234 S. Langley Ave., Chicago, Ill.
Engineer, 170 Mentor Building, Chicago, Ill.

Schultz, William E.—VI '11.....40 N. Prairie Ave., Chicago, Ill.

Schumacher, Joseph Nicholaus—
IV '06.....300 Sheffield Ave., Chicago, Ill.
People's Gas Light and Coke Company, Chicago, Ill.

NAME AND OCCUPATION. ADDRESS.

Scott, Patrick John—II '06, M. E. '11.Butte, Mont.
General Manager, Bamar Copper Co., 312 State Savings Bank, Butte, Montana.

See, Pierre V. C.—III '04, E. E. '10..75 Van Reypen St., Jersey City, N. J.
Superintendent Car Equipment, Hudson & Manhattan R. R. Co., Jersey City, N. J.

Sharp, Herbert Moore—I '05.....Bryan, Ohio.
County Surveyor, Bryan, Ohio.

Shedd, Milton C.—II '09.....409 Montana St., El Paso, Texas.
Assistant Engineer, with W. E. Anderson, Contracting Engineer, El Paso, Texas.

Sheibley, Frank Delbert—III '97....2330 Seventh Ave., New York City, N. Y.
Assistant Engineer, Consolidated Telegraph and Electric Subway Co., 54-60 Lafayette St., New York City, N. Y.

Sherman, Robert Frank—IV '08....1226 S. Capitol St., Pekin, Ill.
Chief Chemist, Pekin Plant, Corn Products Refg. Co., Pekin, Ill.

Sherman, Stanley B.—III '03.....611 Stone St., Flint, Mich.
Superintendent, Flint Gas Company, Flint, Mich.

Sherwin, Edward B.—III '10.....North Chicago, Ill.

Shimizu, Hohson Sanjiro—II '03...4503 Racine Ave., Chicago, Ill.
Designing Engineer, Roberts & Schaefer Co., Old Colony Bldg., Chicago, Ill.

Shubart, Benedict—II '99.....4337 East 18th St., Denver, Colo.
Lindrooth, Shubart & Company, Boston Building, Denver, Colo.

Sieck, Herbert—IV '11.....619 Deming Place, Chicago, Ill.
Chemist in Charge, 2525 West 18th St., Chicago, Ill.

Sieck, William—II '11.....619 Deming Place, Chicago, Ill.
With the N. K. Fairbank Co., 18th St. & Wentworth Ave., Chicago, Ill.

Sigwalt, Elmer—III '07.....Chicago, Ill.
With the Board of Supervising Engineers, Borland Bldg., Chicago, Ill.

da Silva, Claudio J.—I '11.....2409 S. Ridgeway Ave., Chicago, Ill.
With Ford, Bacon & Davies, Valier, Montana, Land & Water Co., Valier, Mont.

Silver, Emile I.—I '04, C. E. '11.....4953 Prairie Ave., Chicago, Ill.
General Superintendent, Alfred S. Alschuler, Architect, 39 Jackson Blvd., Chicago, Ill.

Simmons, Leslie E.—III '09.....722 North Kenilworth Ave., Oak Park, Ill.
Western Electric Company, Hawthorne, Ill.

Simons, L. A.—I '11.....2446 Jackson Blvd., Chicago, Ill.
Construction Department, Swift & Co., Chicago, Ill.

Simpson, Tracy W.—III '09.....7805 Peoria St., Chicago, Ill.
Head of the Bureau of Works Methods, The International Harvester Co., 606 So. Michigan Ave., Chicago, Ill.

Sims, William Fargo—III '97, E.E.'03.Keokuk, Iowa.
Engineer, Stone & Webster Engineering Corporation, Boston, Mass.

Singer, Sidney Charles II '97, M.E.'10.Syracuse, N. Y.
Superintendent of Distribution, Syracuse Lighting Company, Syracuse, N. Y.

Sklovsky, Max—III '00, M. E. '11...624 10th St., Moline, Ill.
Chief Engineer, Deere & Company, Moline, Ill.

Slaker, Harry Joseph—III '98, E. E. '02.....Scarborough, N. Y.
Melter and Refiner, United States Assay Office, New York City.

NAME AND OCCUPATION. ADDRESS.

Sleezer, Frank Walter—III '07.....727 Luttrell St., Knoxville, Tenn.
Ass't Superintendent, Knoxville Gas Light Co., Knoxville, Tenn.

Sloan, James Richard—III '97,
E. E. '02.....Altoona, Pa.
Electrician, Electric Car Lighting, P. R. R., Altoona, Pa.

Smalley, J. Shepard—III '07.....Muscatine, Iowa.
Automobile Engineer, Muscatine, Iowa.

Smalley, Ralph E.—V '11.....897 Marshall Ave., St. Paul, Minn.
Instructor of Mechanical Drawing, High School, St. Paul, Minn.

Smith, Clarence Urling—II '07,
C. E. '11.....117 16th Ave., Spokane, Wash.
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Smith, Earl John Lewis—VI '06....208 Woodbine Ave., Wilmette, Ill.
Fire Protection Engineer, Underwriters' Laboratories, 207 East Ohio St., Chicago, Ill.

Smith, George W.—III '06.....155 San Jacinto St., Dallas, Tex.
Erecting Engineer, Jones Engineering Co., Dallas, Texas.

Smith, Hallam C.—IV '09.....3336 Michigan Ave., Chicago, Ill.
Chemist, People's Gas Light & Coke Co., Archer Ave. and Hough Place, Chicago, Ill.

Smith, Monroe Adney—I '10.....5247 Vernon Ave., St. Louis, Mo.
Sales Department, Corrugated Bar Co., Broadway and Pine Sts., St. Louis, Mo.

Smith, Schuyler Morton—I '11.....Three Rivers, Mich.
Assistant Engineer, Chicago & N. W. R. R. Co., Pekin, Ill.

Snowden, Charles Rossiter—III '05.Y. M. C. A., 3d St., Columbus, Ohio.
Columbus Citizen Telephone Company, Columbus, Ohio.

Soper, Ellis—II '09.....1110 The Ford Bldg., Detroit, Mich.
President, The E. Soper Co.

Souther, Sidney Algernon—III '08..7644 Emerald Ave., Chicago, Ill.
Maintenance Supervisor, Chicago Works, Allis-Chalmers Co., 12th St. & Washtenaw Ave., Chicago, Ill.

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Assistant Engineer, Water Pipe Extension Dept., City of Chicago, City Hall, Chicago, Ill.

Spitzglass, Jacob M.—II '09.....1345 N. Robey St., Chicago, Ill.
Engineering Department. Peoples Gas Light & Coke Co., Chicago, Ill.

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Power Apparatus Specialist, Western Electric Co., Chicago, Ill.

Stagg, Milton V.—III '07.....Ft. Wayne, Ind.
Chief of Meter Dept., Ft. Wayne & Wabash Valley Traction Co., Ft. Wayne, Ind.

Stanton, Gustav, Jr.—I '07.....964 Balmoral Ave., Chicago, Ill.
The William Deering Coal Company, 810 Old Colony Bldg, Chicago, Ill.

Starkweather, E. V.—III '99.....18 Whittier St., East Orange, N. J.
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NAME AND OCCUPATION. ADDRESS.

Stevens, Roe Loomis—I '08.....4835 Forrestville Ave., Chicago, Ill.
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Stillson, Howard George—III '03...

Strang, Rupert Hurd—III '04.....Richland Center, Wis.
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Strickler, John Franklin—II '03.....553 Sherman Ave., Evanston, Ill.
Secretary, John S. Metcalf Company, Grain Elevator Engineers, 623 Woman's Temple, Chicago, Ill.

Strong, Arthur P.—III '09.....138 S. Scoville Ave., Oak Park, Ill.
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Strube, Harry Louis—II '06.....6820 Lowe Ave., Chicago, Ill.
Draftsman, John A. Radford, Chicago, Ill.

Sturgess, Frederick M.—III '07.....2618 Avenue H., Ensley, Ala.
Chief Electrician, American Steel & Wire Co., Birmingham, Ala.

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Squair, F. R.—IV '10.....Washington, D. C.
Assistant Examiner, U. S. Patent Office, Washington, D. C.

Szeszychi, Ignatius—I '11.....Chicago, Ill.

Tarbell, Clarence Lyle—II '99,
M. E. '04.....2326 Rosewood Ave., Toledo. Ohio.
Secretary and Manager, The Union Construction Company, Toledo, Ohio.

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Teesdale, Clyde Harry—IV '08.....Madison, Wis.
Engineer in Wood Preservation, Forest Service, Department of Agriculture, University of Wisconsin, Madison, Wis.

Tellin, William G—III '11.....Newton, Kan.
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Thatcher, Walter C.—III '10.....451 E. 46th St., Chicago.
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Thomas, William Edward—II '10....Y. M. C. A. Bldg, Milwaukee, Wis.
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NAME AND OCCUPATION. ADDRESS.

Thompson, John Kring—IV '05.....8200 Jeffrey Ave., Chicago, Ill.
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Thompson, Maynard Legrand—
V '08.....Muscatine, Iowa.
Secretary, Thompson Bros. Co., Muscatine, Iowa.

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Tobias, W. R.—I '11.....9235 Pleasant Ave., Chicago, Ill.

Tompkins, George D.—I '07, C. E. '11.Yuma, Arizona.
Hydrographer, U. S. Reclamation Service, Yuma, Arizona.

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Western Steel Car & Foundry Co., Hegewisch, Ill.

Twitchell, Frederick W.—III '99....632 South Kedzie Ave., Chicago, Ill
Head Draftsman, Featherstone Foundrys Machine Company, Chicago, Ill.

Tyler, Alva Warren—III '05.....432 N. 53rd Ave., Chicago, Ill.
Designing Engineer, W. S. Gypsum Company, Chicago, Ill.

Urson, Frank J., Jr.—I '09.....2517 N. Sawyer Ave., Chicago, Ill.
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Vacek, Vincent Frank—III '08.....312 24th St., South Omaha, Neb.

Valerio, Joseph M.—III '09.....825 S. Halsted St., Chicago, Ill.
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Van Etten, F. C.—III '09.....1923 College Ave., Davenport, Iowa.
Chief Electrician, Rock Island Arsenal, Rock Island, Ill.

Vey, Frank Eugene—I '05,
C. E. '09.....3122 Osgood St., Chicago, Ill.
Structural Engineer, the Chicago, Milwaukee & St. Paul Railroad Co., Railway Exchange Bldg., Chicago, Ill.

Vynne, Eustace—I '10.....3249 Groveland Ave., Chicago, Ill.
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Wachs, Theodore—II '07.....2725 Pine Grove Ave., Chicago, Ill.
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Wagner, Arthur—III '03, E. E. '08..355 E. 59th St., Chicago, Ill.
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Walbridge, John T.—I '07, III '09,
C. E. '11.....7556 Stewart Ave., Chicago, Ill.
Consulting and Contracting Engineer, 204 So. Michigan Blvd., Chicago, Ill.

Wallace, Ernest Leroy—III '02,
E. E. '11.....Reler, Va.
Assistant Examiner, U. S. Patent Office, Washington, D. C.

NAME AND OCCUPATION. ADDRESS.

Walther, Frederick Peter—III '00..135 William St., New York City, N. Y.
Insurance Engineer, National Board of Underwriters, New York City, N. Y.

Walther, Ralph A.—I '09.....6436 Lowe Ave., Chicago, Ill.
Walther & Suhr, Engineers and Contractors, 106 North La Salle St., Chicago, Ill.

Wanner, Franklin Andrew—II '06..1254 Thorndale Ave., Chicago, Ill.
Sales Advertising Manager, A. F. Wanner Machinery Company, 215 W. Congress St., Chicago, Ill.

Warren, William—III '99.....Deceased.

Watson, Vernon Spencer—V '00....643 Fair Oaks Ave., Oak Park, Ill.
Architect, Tallmadge & Watson, Room 1004, Security Bldg., Chicago, Ill.

Watt, James McCombie—II '04,
M. E. '09.....6106 Ellis Ave., Chicago, Ill.
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Webb, Alexander Raffen—I '08.....Arcadia, Fla.
Engineer, Murdoch Land Company, Arcadia, Fla.

Weber, Eugene Randolph—II '03....419 Cogan Ave., Milwaukee, Wis.
Chief Draftsman, Bucyrus Co., South Milwaukee, Wis.

Week, John Elmer—III '02.....Deceased.

Weinsheimer, Warren E.—III '98...3028 Calumet Ave., Chicago, Ill.
President, Weinsheimer Company, Monadnock Block, Chicago, Ill.

Weisskopf, Maurice Joseph—I '03...608 Blue Island Ave., Chicago, Ill.

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With Superintendent of S. P. L. A. & S. L. R. R. Co., Berkeley, Cal.

Wendell, Raymond B.—III '07.....6530 Lexington Ave., Chicago, Ill.
Division Operator, Public Service Co., 908 Clark St., Evanston, Ill.

Wendt, Samuel John William—
III '03, E. E. '08.....Waukegan, Ill.
With the North Shore Electric Company, Waukegan, Ill.

Wernick, Frank Edward—II '10..... Hillsboro, Wis.
With Deere & Co., Moline, Ill.

Wheeler, H. McIntyre—III '07.....7749 Emerald Ave., Chicago, Ill.
With Yeomans Brothers, 416 West Indiana St., Chicago, Ill.

Wheeler, John Jones—II '97.....2015 Division St., Baltimore, Md.
Superintendent of Shops, Colored High and Manual Training School, Baltimore, Md.

White, Ernest Cantelo—II '99,
M. E. '06.....4889 Sherbrooke St., Montreal, Can.
Merchant, Lighting Fixtures, 444 Guy Street, Montreal, Canada.

Whitmore, Ray—III '10.....1226 Rawson Ave., South Milwaukee, Wis.
With the Allis-Chalmers Co., Norwood, Ohio.

Whitney, Fred Boston—I '05.....Minot, N. D.
Assistant Engineer, Great Northern R. R. Co., Minot, N. D.

Wiard, Walter H.—IV '09.....146 North St., Waukegan, Ill.
Chemist, Chicago Hardware Foundry Co., North Chicago, Ill.

Wickerham, Adam George—V '08...100 E. 9th Ave., Homestead, Pa.
Architect, Homestead, Pa.

NAME AND OCCUPATION. ADDRESS.

Wickersham, Edward James—II '04, III '05 .....6237 Kimbark Ave., Chicago, Ill.

Wight, Robert Adams—IV '07.....5717 West End Ave., Austin Station, Chicago, Ill.
Assistant Engineering Chemist, Testing Dept., City Lab., Chicago Ave. Pumping Station, Chicago, Ill.

Willard, Donald E.—II '05.....Chicago, Ill.
Engineer, Allith Manufacturing Co., Taylor Street and 43d Avenue, Chicago, Ill.

Williams, Duvall—I '10.....1102 Church St., Evanston, Ill.
Engineering Department, City of Evanston, Evanston, Ill.

Williams, Guy E.—III '11.....Duluth, Minn.

Williams, Lytle L.—III '11.....Great Falls, Mont.
With the Great Falls Power Company, Great Falls, Mont.

Williams, Roy Edmund—III '04.....Hutchinson, Kan.
Engineer, Hutchinson Chemical & Alkali Company, Hutchinson, Kan.

Williams, Wallace—III '07.....6440 Normal Blvd., Chicago, Ill.
With the Alpha Glass Company, Chicago, Ill.

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Wilsnack, George Carl—IV '08.....11745 State St., Chicago, Ill.
With the International Harvester Co., Blue Island and Western Aves., Chicago, Ill.

Wilson, Fred Norwood—II '06.....619 E. 41st St., Chicago, Ill.
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Wilson, William Robert—II '06, M. E. '11.....122 Clairmont Ave., Detroit, Mich.
With the Studebaker Corporation, Detroit, Mich.

Winser, Roy Alexander—IV '08.....203 North Ave., Aurora, Ill.
Chemist, Chicago, Burlington & Quincy Railway Co., Aurora, Ill.

Witte Otto Albert—III '11.....3420 Pierce Ave., Chicago, Ill.
With the Commonwealth Edison Co., Testing Dept., 28 N. Market St., Chicago, Ill.

Woldenberg, Maxmilian—IV '06....3334 Vernon Ave., Chicago, Ill.
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Wolfe, Edward John—III '07.....7048 Vincennes Ave., Chicago, Ill.
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Wolters, George F.—V '08.....426 E. 41st St., Chicago, Ill.
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Wright, Melville Edwin—III '05....New York City.
Telephone Engineer, 15 Key St., New York City.

Wuehrmann, William Gerhard—V '08.....5324 S. Ashland Ave., Chicago, Ill.
With A. S. Alschuler, Architect, Steger Bldg., Chicago, Ill.

Young, Lerton Burdell—I '07.....6155 Michigan Ave., Chicago, Ill.
With the Pennsylvania Railway Company, Canal and Adams Sts., Chicago, Ill.

Young, Donald A.—II '10.....Delagua, Col.

Youngberg, Harry W.—I '09.....260 Chase St., Gary, Ind.
With the American Bridge Company, Gary, Ind.

Zack, Raymond R.—I '11.....Idaho Springs, Colo.
With the Silver Horn Mining Company, Idaho Springs, Colo.

NAME AND OCCUPATION. ADDRESS.

Zanzig, Frank C.—III '09.....1453 8th St., Milwaukee, Wis.
With Vaughn & Meyers, Consulting Engineers, Milwaukee, Wis.

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With the Western Electric Co., Chicago, Ill.

Zimmerman, Frederick William—
III '00.....4117 Perry St., Chicago, Ill.
Instructor in Drawing, Lane Technical High School, Chicago, Ill.

Zimmerman, Samuel Louis—I '08...1312 Turner Ave., Chicago, Ill.
Engineering Department, Chicago & Northwestern Railroad, Omaha, Neb.

Zuckerman, Herbert Gladstone—
IV '04.....Mendicino Ave., North Brae, Berkeley, Cal.
Weyl-Zuckerman & Co., San Francisco, Cal.

GRADUATES OF THE COLLEGE OF ENGINEERING BY YEARS.

Class	*M.E.	E.E.	C.E.	Ch. E.	F.P.E.	A.	Total
1897	5	17	..	..	..	..	22
1898	1	12	..	..	..	2	15
1899	8	20	..	..	..	3	31
1900	3	12	1	..	..	1	17
1901	3	12	..	1	..	..	16
1902	8	17	3	2	..	2	32
1903	8	15	6	2	..	..	31
1904	10	16	5	2	..	1	34
1905	12	21	8	5	..	1	47
1906	21	17	13	8	4	3	66
1907	16	24	19	6	2	..	67
1908	12	17	21	9	2	7	68
1909	13	27	19	7	4	3	73
1910	15	17	17	3	2	7	61
1911	11	29	24	6	6	7	83
Total	146	273	136	51	20	37	663

*M. E.—Mechanical Engineering.
E. E.—Electrical Engineering.
C. E.—Civil Engineering.
Ch. E.—Chemical Engineering.
F. P. E.—Fire Protection Engineering
A.—Architecture.

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